SELECTED

# **SWATER**RESOURCES ABSTRACTS



VOLUME 14, NUMBER 11 JUNE 1, 1981

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# WATER RESOURCES ABSTRACTS

A semimonthly publication of the Office of Water Research and Technology, U.S. Department of the Interior

VOLUME 14, NUMBER 11 JUNE 1, 1981

W81-01901 -- W81-02150





The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

# PREFACE

elected Water Resources Abstracts, a S elected Water Resources abstracts of semimonthly journal, includes abstracts of lournal current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the Water Resources Thesaurus. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology U.S. Department of the Interior Washington, D.C. 20240

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# SELECTED WATER RESOURCES ABSTRACTS

#### 2. WATER CYCLE

#### 2A. General

AN ASSESSMENT OF STORM SURGE MOD-

Water Resources Council, Washington, DC For primary bibliographic entry see Field 2L. W81-01935

#### 2B. Precipitation

KINEMATIC DESIGN STORMS INCORPORATING SPATIAL AND TIME AVERAGING, McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics. W. James, and J. J. Drake.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173858, Price codes: Al I in paper copy, A01 in microfiche. In: Proceedings, Stormwater Management Model (SWMM) Users Group Meeting, 19-20 June, 1980, Toronto, Ontario, Environmental Protection Agency EPA 600/9-80-064, December, 1980, p 133-149, 7 Fig, 1 Tab, 19 Ref.

Descriptors: \*Design storms, \*Rainfall-runoff relationships, \*Model studies, Storm runoff, Urban runoff, Storm water, \*Water pollution, Hydrographs, Distribution patterns, Rainfall intensity.

Traditionally, design storms have been developed from statistical analysis of point rainfall records that include all types of rainstorms. The resultant rain distributions are unlike any type of observed rain storm. This synthetic temporal distribution is rain storm. This syndretic temporal distribution is typically applied uniformly across the catchment and flow hydrographs are also unlike observed runoff hydrographs. The storm model presented in this study is based on the synoptic observations of this study is based on the synoptic observations of rain cells reported in weather radar literature. The model generates hydrographs for each subcatch-ment, thus simulating the spatial and temporal growth and decay of a system of storm cells as they move across an urban catchment system. In-tensity-duration-frequency curves obtained from the model are similar to those derived statistically from the long-term rainful record. The model is from the long-term rainfall record. The model is applied to catchments in the Hamilton area in South Ontario, Canada. Results indicate that storm cell kinematics are significant, particularly in peak runoff estimates for drainage design and water pollutant loading estimates, because of the sensitivity of the time to peak and rate of rise of hydro-graphs and pollutographs. Such storm models appear to be useful for computer based rainfall-runoff studies. (Moore-SRC) W81-01928

SPATIAL AND SEASONAL PRECIPITATION DISTRIBUTION IN SOUTHWEST IDAHO, Science and Education Administration, Boise, ID. C. L. Hanson, R. P. Morris, R. L. Engleman, D. L. Coon, and C. W. Johnson. Science and Education Administration, Oakland, California, Agricultural Reviews and Manuals ARM-W-13, April, 1980. 15 p, 7 Fig, 5 Tab, 12 Ref.

Descriptors: \*Idaho, \*Precipitation(Atmospheric), \*Distribution patterns, \*Elevation, Spatial distribution, Temporal distribution, Seasonal, Store, Mountains, Precipitation gages, Time, Hydrology, Watersheds(Basins).

Analysis of the 16 year record from the precipita-tion gage network on the Reynolds Creek Experi-mental Watershed in southwest Idaho shows that the average annual precipitation ranged from 250 mm on the low elevation (1100 m) areas of the watershed to 1100 mm on the high elevation (2160 m) areas. There was a linear relationship between summer (May through October) precipitation and summer (May through October) precipitation and elevation and winter (November through April) precipitation and elevation. July and August storm durations averaged about 3.6 hr at both the low and high elevations. December and January storms averaged 5.2 hr duration at the low elevations and 8.6 hr at the high elevations. The average interval between storms during July and August was 7.7 days at the low elevation site and 6.6 days at the high elevation site. The average interval between storms during December and January was 2.9 days at the low elevations and 1.7 days at the high elevations. At all elevations, the interval between storms was longer for the two summer months storms was longer for the two summer months than for the two winter months. The 2-yr 6-hr precipitation at the low elevations was 20 mm. The 2-yr 6-hr precipitation at the high elevations was about 40 mm. These analyses show precipitation characteristics of a mountainous area from a dense precipitation gage network and provide data for hydrologic modeling and resource inventory evaluation. (Moore-SRC) W81\_01938

MODEL OF TIME AND SPACE DISTRIBU-TION OF RAINFALL IN ARIZONA AND NEW

Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research H. B. Osborn, E. D. Shirley, D. R. Davis, and R.

Science and Education Administration, Oakland, California, Agricultural Reviews and Manuals ARM-W-14, May, 1980. 31 p, 14 Fig, 6 Tab, 10 Ref. 1 Append.

Descriptors: \*Rainfall disposition, \*New Mexico, \*Arizona, \*Model studies, \*Simulated rainfall, Watersheds(Basins), Hydrology, Range manages, Depth-area-duration analysis, Distribution patterns, Runoff forecasting, Time, Isohyets, Mapping.

Rainfall data from two dense rain gage networks, Rainfail data from two dense rain gage networks, several small groups of rain gages, and National Weather Service rain gages are used to describe the occurrence and depth-area distribution of rainfall and to develop a rainfall simulation program (model) for Arizona and New Mexico. Depth-area rainfall distribution is described by an assumed cellular thunderstorm structure, with verification limited to comparison of simulated and actual total rainfall patterns. Simulated rainfall is convenient to use in hydrologic models when long term rainfall use in hydrologic modes when long term raintain records are unavailable. If point records are availa-ble, they can be used to verify the model. The program output includes accumulated seasonal rainfall for any designated point (gage), point totals for individual events for isohyetal mapping, start-ing and ending times for all events, and Thiessen weighted watershed averages. The output can be used directly to estimate peaks and volumes of runoff for very small watersheds (up to 100 hectares), and indirectly for larger watersheds with appropriate routing methods. Since the rainfall is distributed both in time and space, simulations of several years of record could be used to provide probabilities of wet and dry sequences to evaluate the chances of success for range renovation pro-grams and could aid ranchers in overall planning of range management programs. (Author's ab-W81-01939

THE DISTRIBUTION OF KINETIC ENERGY OF RAINFALL IN SOUTH AFRICA - A FIRST ASSESSMENT,
Natal Univ., Pietermaritzburg (South Africa).

Dept. of Agricultural Engineering. R. E. Schulze. Water SA, Vol 6, No 2, p 49-58, April, 1980. 6 Fig. 1 Tab, 18 Ref.

Descriptors: \*Erosion, \*Rain, \*Kinetics, Energy, Africa, Weathering, Impact(Rainfall), Precipitation(Atmospheric), South Africa.

Rainfall kinetic energies were derived from re-Rainfall kinetic energies were derived from re-cords of rainfall intensity measured at 14 stations located in a variety of rainfall regions in South Africa. The generalized relationship between kinetic energy (E) and rainfall intensity (I) is estab-lished at the monthly level of data using the Soil Loss Estimation Model for Southern Africa (SLEMSA) equation for E, and from these, mean annual, summer and winter distributions of E are mapped for the republic. In order to relate studies of soil erosion to rainfall, the intensity, size distribution, fall velocity and angle of impact of the button, fall velocity and angle of impact of the raindrops must be known. The rainfall intensity is comparatively easily measured, and relationships between the energy and the intensity have been sought. Studies are currently being conducted on physically based soil loss models. As information is paysically observed with the magnitudes and patterns of rainfall energy in South Africa, efforts are underway to determine regional rainfall energy equations and map distributions of E. (Baker-FRC)

A DEPTH-AREA-DURATION MODEL OF STORM RAINFALL IN THE SOUTHERN GREAT PLAINS,

Science and Education Adminstration, Chickasha, OK

A. D. Nicks, and F. A. Igo.

Water Resources Research, Vol 16, No 5, p 939-945, October, 1980. 8 Fig, 14 Ref.

Descriptors: \*Depth-area-duration Storms, \*Runoff forecasting, \*Rainstorms, Hyeto-graphs, Depth-area curves, Mathematical models, Least squares method, Great Plains, \*Oklahoma, Rainfall-runoff relationships.

A depth-area-duration model for Oklahoma rainstorms was developed using 10 years of data from a dense network of recording rain gages spaced on a 5 by 5 km grid. The model relates mean depth of rainfall over a given area to storm center rainfall depth. Nonlinear least squares optimization was used to fit the data from 138 storms to the model. The model was tested using storm isohyetal maps available from published storm reports. In one case, the model simulation of the depth-area curve underestimated the actual depth by 23% at 777 sq km. This result was within the error found from network data tested with the model: mean errors ranged from 8% on 130 sq km to 27% on 3100 sq km. The model can be used to convert storm center point rainfall amounts to mean rainfall in areas up to 3100 sq km. The model seems to have predictive value, especially for storms which occur in the Great Plains area. (Small-FRC) W81-01964

#### 2C. Snow, Ice, and Frost

A MODEL FOR THE PREDICTION OF ICE LENSING AND FROST HEAVE IN SOILS,

Alberta Univ., Edmonton. Dept. of Mechanical Engineering. R. R. Gilpin.

Water Resources Research, Vol 16, No 5, p 918-930, October, 1980. 11 Fig, 18 Ref.

Descriptors: \*Frost heaving, \*Physical models, Ice, \*Soil properties, \*Ice lenses, Thermal conductivity, Hydraulic properties, Water properties,

A physical model based on the freezing of a saturated matrix of uniform spheres exhibited many of the characteristics observed in the frost heave of soils. If the radius of the spheres is equal to the radius of the finest 10% of the soil, the magnitudes of the heave rates are similar. Four factors were found to control heave rate: (1) the rate of heat conduction away from the freezing front. (2) the hydraulic resistance in the frozen fringe, (3) the hydraulic resistance at the ice lens, and (4) the hydraulic resistance in the unfrozen soil. The model predicts ice lensing and heave rates as functions of basic soil properties, and the results are in general agreement with experimental observations. The model does not account for changes in consolidation of the soil that may occur as a result in changes in pore ice pressure. In the model, the soil particles are assumed to form a rigid skeleton which breaks only when the ice pressure exceeds some specific pressure. (Small-FRC)

#### Group 2E-Streamflow and Runoff

#### 2E. Streamflow and Runoff

CONSIDERATIONS REGARDING THE APPLICATION OF SCS TR-55 PROCEDURES FOR RUNOFF COMPUTATIONS,

Ottawa Univ. (Ontario). Dept. of Civil Engineer-

ing.
P. Wisner, S. Gupta, and A. Kassem.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-173858,
Price codes: Al1 in paper copy, A01 in microfiche.
In: Proceedings, Stormwater Management Model
(SWMM) Users Group Meeting, 19-20 June, 1980,
Toronto, Ontario, Environmental Protection
Agency Report EPA 600/9-80-064, December,
1980, p 23-44. 6 Fig. 5 Tab, 18 Ref.

Descriptors: \*Runoff forecasting, \*Model studies, \*Storm water, Hydrographs, Rainfall - runoff relationships, Streamflow, Peak discharge, Watersheds(Basins), Infiltration rates, Design storm.

The Soil Conservation Service (SCS) Technical Release 55 (TR-55) presents simplified tabular and graphical methods for estimating runoff volumes, peak discharges and discharge hydrographs for runoff computations. The SCS TR-55 computational procedures and data requirements are critically reviewed. A comparative assessment of peak discharge and hydrograph computations with other widely used models was carried out using several hypothetical watersheds. Limitations introduced by the meteorological input assumptions and the methodology for calculation of infiltration and other losses include: a particular distribution and a specific duration design storm, and weighted averaging of curve numbers for pervious and impervious areas which may lead to overestimation of rainfall losses corresponding to one half to one tenth-year storms. The two procedures for peak discharge computations in TR-55 lead to different results. The second method giving peak flows in terms of areas and slopes seems to significantly underestimate peak flows. For the same meteorological input and rainfall losses, simulations carried out by the time of concentration method underestimated the peak flows for areas up to 160 acres as compared to Storm Water Management Model. The tabular procedures in the SCS TR-55 or routing runoff hydrographs through stream channels seem to underestimate the flows and can be used only in conjunction with a 24 hour, Type II storm. Use of the convex method seems to be more accurate and can be used for any hydrograph profile. (Moore-SRC) W81-01923

A SIMPLIFIED STORMWATER QUANTITY AND QUALITY MODEL,

Akron Univ., OH. Dept. of Civil Engineering. S. Sarikelle, and Y-T. Chuang. Available from the National Technical Information Service, Springfield, VA 22161 as PBB1-173858, Price codes: Al 1 in paper copy, AOI in microfiche. In: Proceedings. Stormwater Management Model (SWMM) Users Group Meeting, 19-20 June, 1980, O Toronto. Ontario. Environmental Protection Agency Report EPA 600/9-80-064, December, 1980, p 45-63. 8 Fig. 1 Tab, 13 Ref.

Descriptors: \*Urban runoff, \*Storm runoff, \*Model studies, \*Water pollution, Computer programs, Water quality, Storm water, Small watersheds, Hydrographs.

Most existing stormwater models have complicated structure, require extensive input data, and do not incorporate the qualitative aspect of the urban runoff phenomena efficiently. A quantity and quality urban runoff simulation model with simple input requirements was developed to be used in the planning and analysis of stormwater systems. The Modified Linearized Subhydrographs Urban Runoff Model (MLSUPM) consists of a quantity submodel and a quality submodel. The model was applied to two typical urban drainage areas with measured runoff data corresponding to various gaged storm events. The model simulated stormwater hydrograph well for small urban catchments with little calibration effort. The successful simula-

tion of hydrographs for large watersheds is also achieved if the watersheds are subdivided into small catchements. Satisfactory pollutograph simulations were also obtained by using calibrated parameter values. The model may be used as an alternative to the more comprehensive and complex models in the planning and analysis of stormwater systems. It incorporates simple but physically realistic parameters in the simulation of runoff of stormwater. (Moore-SRC)

METHODOLOGY FOR 'LUMPED' SWMM MODELLING,

Edmonton Water and Sanitation Dept. (Alberta).

M. Ahmad.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-173858,
Price codes: A11 in paper copy, A01 in microfiche.
In: Proceedings, Stormwater Management Model
(SWMM) Users Group Meeting, 19-20 June, 1980,
Toronto, Ontario, Environmental Protection
Agency Report EPA 600/9-80-064, December,
1980, p 64-79. 14 Fig, 2 Tab, 7 Ref.

Descriptors: \*Urban runoff, \*Storm runoff, \*Model studies, \*Storm drains, Hydrographs, Rainfall-runoff relationships, Urban drainage, Canada, Methodology, Costs.

A systematic methodology is presented for lumping or aggregating urban drainage areas when using the Storm Water Management Model (SWMM) to simulate the rainfall-runoff process. In a lumped model the study area is discretized into large subcatchments, and as such the spatial details of hydrologic characteristics and the internal drainage system are not explicitly modelled. As a part of the simplified methodology, the concept of equivalent gutter was introduced in RUNOFF block simulation to compensate for the eliminated conduit storage existing within the lumped catch-ment. A set of generalized curves relating in-system conduit storage to impervious area were developed using relevant data from new residential and industrial subdivisions in Edmonton, Canada. Curves relating the drainage area to the peak flow for a range of imperviousness values were also generated. A systematic step by step procedure that uses these curves to determine the overland flow width parameter and the dimensions of the representative equivalent gutter appropriate for the lumped catchment was formulated. The lumping methodology was tested against detailed simulations using rainfall and flow measurements for three recorded storm events for the Norwood test area. Modelling results employing lumped and dethree recorded storm events for the Norwood test area. Modelling results employing lumped and de-tailed schemes, respectively, were also compared for the 5-year design storm using the catchment data for the Fulton Drive basin. Comparisons of detailed and lumped simulations for both test areas were found to be reasonably good. A significant reduction both in the amount of effort required in input data preparation and in the overall simulation costs can be achieved by employing this lumping methodology. (Moore-SRC) W81-01925

CHARACTERIZATION, MAGNITUDE AND IMPACT OF URBAN RUNOFF IN THE GRAND RIVER BASIN,

Ontario Ministry of the Environment, Ottawa. Water Resources Branch. For primary bibliographic entry see Field 5B.

DEVELOPMENT OF AN URBAN HIGHWAY STORM DRAINAGE MODEL BASED ON SWMM,

Camp, Dresser and McKee Inc., Springfield, VA. For primary bibliographic entry see Field 8A. W81-01927

KINEMATIC DESIGN STORMS INCORPO-RATING SPATIAL AND TIME AVERAGING, McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics. For primary bibliographic entry see Field 2B. W81-01928

HYDROGRAPH SYNTHESIS BY THE HNV-SBUH METHOD UTILIZING A PROGRAM-MABLE CALCULATOR,

Howard, Needles, Tammen and Bergendoff, Orlando, FL.

B. L. Golding.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-173858,
Price codes: A11 in paper copy, A01 in microfiche.
In: Proceedings, Stormwater Management Model
(SWMM) Users Group Meeting, 19-20 June, 1980,
Toronto, Ontario, Environmental Protection
Agency Report EPA 600/9-80-064, December,
1980. p 150-177. 36 Fig, 8 Tab, 11 Ref.

Descriptors: \*Urban runoff, \*Hydrographs, \*Model studies, \*Runoff, Computer programs, Rainfall-runoff relationships, Urban drainage, Soil properties, California, \*Santa Barbara Urban Method(Runoff).

The Howard Needles Version of the Santa Barbara Urban Hydrograph Method (HNV-SBUH Method) is a fairly simple, yet easily applied low cost model for computing design flow hydrographs using either a programmable pocket calculator or a microcomputer. The HNV-SBUH Method with the four standard infiltration curves is an effective method of simulating acceptable runoff hydrographs from urban drainage basins. Hydrographs can be computed in 20 minutes on a programmable calculator and in 10 minutes on a microcomputer by an engineering technician. In this method, the final design hydrograph is obtained by routing the instantaneous hydrograph for each time period, obtained by multiplying the incremental rainfall excesses by the entire watershed area in acres, through an imaginary linear reservoir with a routing constant equivalent to the time of concentration of the drainage basin. Four urban drainage basins of different sizes, locations and character were selected for use in model validation. Runoff hydrographs from residential areas or other urban areas with less than 50% impervious cover are extremely sensitive to antecedent moisture conditions and the infiltration capacity of the soil in the basin such that the use of a more ophisticated model may not be warranted. (Moore-SRC)

A REPRESENTATION OF AN INSTANTA-NEOUS UNIT HYDROGRAPH FROM GEO-MORPHOLOGY,

Mississippi Univ., University. Dept. of Civil Engineering.

Water Resources Research, Vol 16, No 5, p 855-862, October, 1980. 4 Fig, 25 Ref.

Descriptors: \*Mathematical models, \*Geomorphology, \*Rainfall-runoff relationships, Hydrographs, Watersheds(Basins), Water levels, Instantaneous unit hydrograph, Streamflow, River basins.

A probabilistic approach for determining the functional form and the parameters of the instantaneous unit hydrograph was developed on the basis of the geomorphology of a river basin. The channel network and the overland flow regions in a river basin satisfy Horton's empirical geomorphologic laws when ordered according to the Strahler ordering scheme. This setting can be employed in a kinetic theoretical framework for obtaining an explicit mathematical expression for the instantaneous unit hydrograph at the basin outlet. Some preliminary physical ideas are developed for estimating the parameters appearing in the instantaneous unit hydrograph representation in terms of empirical geomorphologic laws of stream numbers, stream lengths, etc. The theoretical results were compared with observed flows for three basins in Illinois. There was good agreement with two larger basins, but an underestimation of the peak flow for the third, smaller basin. Thus, the assumption of linearity of rainfall-tunoff transformation is questionable for smaller basins. (Small-FRC)

#### Streamflow and Runoff-Group 2E

REAL-TIME FORECASTING WITH A CON-CEPTUAL HYDROLOGIC MODEL, I, ANALY-SIS OF UNCERTAINTY, Iowa Univ. Iowa City. Inst. of Hydraulic Re-

search.

For primary bibliographic entry see Field 6A.

REAL-TIME FORECASTING WITH A CON-CEPTUAL HYDROLOGIC MODEL. 2. APPLI-CATIONS AND RESULTS,

Iowa Univ., Iowa City. Inst. of Hydraulic Re-search. For primary bibliographic entry see Field 6A. W81-01963

A DEPTH-AREA-DURATION MODEL OF STORM RAINFALL IN THE SOUTHERN GREAT PLAINS,

Science and Education Adminstration, Chickasha,

For primary bibliographic entry see Field 2B. W81-01964

FAULTING CAUSED BY GROUNDWATER LEVEL DECLINES, SAN JOAQUIN VALLEY, CALIFORNIA,

cal Survey, Menlo Park, CA. T. L. Holzer.

Water Resources Research, Vol 16, No 6, p 1065-1070, December, 1980. 5 Fig. 1 Tab, 22 Ref.

Descriptors: \*Groundwater, \*Land subsidence, \*Geological faults, Withdrawal, Hydrogeology, Settlement, Compaction, Irrigation, Water levels, \*Water level fluctuations, San Joaquin \*Water level fluctuations, Valley(CA), Seasonal.

Collected evidence suggests that faulting in the San Joaquin Valley is related to groundwater level declines caused by groundwater withdrawals for crop irrigation. Modern faulting postdates the beginning of water level declines and associated subsidence. Movement detected in a longterm survey was seasonal, corresponding to water level fluctuations. Fault offset was greater in the year with the lower seasonal low water level. Localized differential compaction across the preexisting fault is proposed as the cause of modern fault movement. (Titus-FRC) W81-01968

A LOGICAL APPROACH TO THE DESIGN STORM CONCEPT,

Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 6A. W81-01971

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE UPPER WISCONSIN RIVER BASIN, WISCONSIN,

Geological Survey, Madison, WI. Water Resources Div.

W. A. Gebert.

W. A. Gebert.

Available from the OFSS, USGS Box 25425, Fed.

Ctr., Denver, CO 80225, Price: \$8.75 in paper copy, \$4.50 in microfiche. Geological Survey Open-File Report 80-691 (WRI), July, 1980. 60 p, 7 Fig. 2 Plates, 3 Tab, 17 Ref.

Descriptors: \*Low flow, \*Streamflow, \*Low flow frequency, \*Streamflow forecasting, \*Regression analysis, Evaluation, Equations, Base flow, Flow characteristics, Flow duration, Flow rates, Wisconsin, \*Upper Wisconsin River basin.

Low-flow characteristics of streams in the upper Wisconsin River basin are presented. Included are estimates of low-flow frequency at 10 gaging stations, flow duration at 8 gaging stations, and low-flow frequency characteristics at 13 low-flow partial-record stations and 81 miscellaneous sites. Equations are provided to estimate low-flow characteristics at ungaged sites and at sites where one base-flow discharge measurement is available. The equations were determined from multiple-regression analyses that related low-flow characteristics at gaging stations and low-flow partial-record sta-

tions to basin characteristics. The standard error of estimate is provided for each method of estimating the annual minimum 7-day mean flow below which the flow will fall on the average of once in 2 years and once in 10 years. The standard error of estimate for the 7-day 10-year low flow ranged from 9% to 113% depending on the type of data available. Standard error provides the user with the expected degree of accuracy for each method. (USGS) W81-02026 tions to basin characteristics. The standard error of

FLOOD OF FEBRUARY 1980 ALONG THE AGUA FRIA RIVER, MARICOPA COUNTY,

ARIZONA,
Geological Survey, Tucson, AZ. Water Resources

B. W. Thomsen.

D. W. 1 HOMSEN. Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$4.75 in paper copy, 50.50 in microfiche. Geological Survey Open-File Report 80-767, June, 1980. 1 Sheet, 4 Fig. 2 Ref.

Descriptors: \*Floods, \*Rainfall, \*Runoff, \*Arizona, Reservoir releases, Flood flow, Flood discharge, Flood recurrence interval, Historic floods, Flood frequency, Regression analysis, Aerial photography, \*Maricopa County(AZ), \*Aqua Fria River(AZ), Lake Pleasant(AZ), Waddell tography, River(AZ), Dam(AZ).

The flood of February 20, 1980, along the Agua Fria River below Waddell Dam, Maricopa County, Ariz., was caused by heavy rains during February 13-20. The runoff filled Lake Pleasant and resulted in the largest release—66,600 cubic feet per second—from the reservoir since it was built in 1927; the maximum inflow to the reservoir was about 73,300 cubic feet per second. The area invalidated by the releases includes about 28 miles along the channel from the mouth of the Agua Fria River to the Beardsley Canal flume crossing 5 miles downstream from Waddell Dam. The flood of 1980 into Lake Pleasant has a recurrence interval of about 47 years, whereas the flood of record (1919) has a recurrence interval of about 100 years. W81-02027

STREAMFLOW CHARACTERISTICS OF THE YELLOWSTONE RIVER BASIN, MONTANA, THROUGH 1976, Geological Survey, Helena, MT. Water Resources

Geological Survey, Island.
Div.
L. G. Moore, and R. R. Shields.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-120859,
Price codes: A04 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations
80-41, July, 1980. 67 p, 2 Fig, 8 Ref.

Descriptors: \*Streamflow, \*Flow characteristics, \*River basins, \*Montana, Data collections, Gaging stations, Crest-stage gages, Low flow frequency, Flow duration, Flood frequency, Surface waters, Water resources development, \*Yellowstone River begin(MT). basin(MT).

Statistical summaries of streamflow data for selected stream-gaging and crest-stage gage sites are presented in this report to aid in appraising the hydrology of the Yellowstone River basin. Montana. Streamflow records presented for 45 gaging stations and 45 crest-stage gages for the period of record. Streamflow record collection in the Yellowstone River basin began in 1889. For each gaging station selected for this report, a brief description is given for station location, drainage area, period of record, revisions of previously published records, type and history of gages, regulation and diversions, and extreme of discharge inside records, type and inside you gages, regularition and diversions, and extremes of discharge. These data are followed by tables of monthly and annual flow statistics, high-flow and low-flow frequency data, flood-frequency data, flow-duration information, and for natural-flow sites selected basin characteristics. For each crest-stage gage, the brief description consists of location, drainage area. period of record, and type and history of gage. This information is followed by tables of flood-frequency data and selected basin characteristics.

AN ANALYSIS OF THE MAGNITUDE AND FREQUENCY OF FLOODS ON OAHU,

Geological Survey, Honolulu, HI. Water Resources Div.

R H. Nakahara.

W81-02041

R. H. Nakahara.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-109902, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-45, June, 1980. 20 p. 1 Fig. 9 Tab. 9 Ref.

Descriptors: \*Floods, \*Peak discharge, \*Flood frequency, \*Regression analysis, \*Hawaii, Analytical techniques, Frequency analysis, Flood peak, Flood forecasting, Flood recurrence interval, Watersheds(Basins), Basin characteristics, Gaging stations, Sites, \*Oahu(HI).

An analysis of available peak-flow data for the island of Oahu, Hawaii, was made by using multiissand or Ganu, rawaii, was made of using muti-ple regression techniques which related flood-fre-quency data to basin and climatic characteristics for 74 gaging stations on Oahu. In the analysis, several different groupings of stations were investigated, including divisions by geographic location and size of drainage area. The grouping consisting of two leeward divisions and one windward division produced the best results. Drainage basins ranged in area from 0.03 to 45.7 square miles. Equations relating flood magnitudes of selected frequencies to basin characteristics were developed for the three divisions of Oahu. These equations can be used to estimate the magnitude and frequency of floods for any site, gaged or ungaged, for any sired recurrence interval from 2 to 100 years. Data on basin characteristics, flood magnitudes for various recurrence intervals from individual sta-tion-frequency curves, and computed flood magnitudes by use of the regression equation are table ed to provide the needed data. (USGS) W81-02042

SEDIMENT SUSPENSION IN TURBULENT PIPE FLOW,

Bechtel, Inc., San Francisco, CA. For primary bibliographic entry see Field 8B. W81-02077

GENERAL ALGORITHM FOR ROUGH CON-DUIT RESISTANCE, Wade, Trim and Associates, Taylor, MI.

For primary bibliographic entry see Field 8B. W81-02078

HYDROLOGIC IMPACT OF DRAINING SMALL DEPRESSIONAL WATERSHEDS, Kentucky Univ., Lexington. Dept. of Agricultural

Engineering. Lagmeering.

I. E. Moore, and C. L. Larson.

Journal of the Irrigation and Drainage Division,

Proceedings of the American Society of Civil Engineers. Vol 106, No 1R4, p 345-363, December,

1980. 9 Fig. 7 Tab, 21 Ref.

Descriptors: \*Runoff, \*Drainage, \*Watershed management, \*Minnesota, Flow rates, Mathematical models, Floods, Storms, Small watersheds.

The Minnesota Model for Depressional Watersheds was developed to study the hydrologic impact of draining small watersheds characterized by numerous depressions. The model was applied to two small watersheds in Jackson County, Minnesota, to determine maximum flow rates on a frequency basis and to determine the effects of various types and degrees of drainage on watershed runoff throughout the year. The physical characteristics of the main water course in the watershed represent the major factor influencing characteristics of the main water course in the watershed represent the major factor influencing peak discharge rates at the watershed outlet. Annual flood flows on the Minnesota River at Mankato suggested that downstream effects of drainage development on large watersheds are much slighter than was indicated by this study on small watersheds. Drainage of individual depres-

#### Field 2—WATER CYCLE

#### Group 2E-Streamflow and Runoff

sions in the watersheds had less effect on peak flows from high intensity, short duration storms than from low intensity storms and storm melt. (Small-FRC) W81\_02080

# DETENTION STORAGE FOR URBAN FLOOD

Espey Huston and Associates, Inc., Dallas, TX. D. P. Smith, Jr., and P. B. Bedient. Journal of the Water Resources Planning and Man-

agement Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR2, p 413-425, July, 1980. 4 Fig. 6 Tab. 17 Ref.

Descriptors: \*Detention reservoirs, \*Flood con-\*Texas, Channels, Water policy, Water convey-ance, Runoff, Water control, Flood protection, Flood recurrence level. River basin development. Watershed management, Hydrology, Flood forecasting.

The effect of the location and size of detention storage on downstream flood flows in an urbaniz-ing watershed was studied using the Corps of Engineers HEC-1 simulation model. The example chosen was Brays Bayou, Houston, Texas, for which extensive hydrologic and land use data was available. This low-relief area, the scene of rapid upstream urbanization, has a history of severe flood damages in spite of a large flood control project implemented in the 1950's. Storage detention alternatives considered rainfall frequency, peak flows and timing, and land use. A baseline, established using existing development with no detention storage, indicated a 10-year storm as the upper limit. In the case of added development with storage only for this newly built-up area, a 5 year storm could be safely carried by the channel. If detention ponds were available in both existing and future development, a 10-year event would be suc-cessfully handled. In the Brays Bayou, added storage areas will not significantly improve flooding conditions because the character of the lower basin dominates. However, in a less urbanized basin, detention storage could protect downstream areas and control sediment and flood waters as the upper basin develops. (Cassar-FRC) W81-02117

# POLITICAL ASPECTS OF URBAN STORM-WATER MANAGEMENT,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.

L. A. Brown.

L. A. Brown. Journal of the Water Resources Planning and Man-agement Divsion, Proceedings of the American Society of Civil Engineers, Vol 106, No WR1, p 265-273, March, 1980. 2 Fig, 3 Tab, 3 Ref.

Descriptors: \*Storm water, \*Urbanization, \*Politi-\*Georgia, Atlanta, Decatur, Planning, Storm runoff, Constraints, Drainage programs, Water Water policy, Administration, Water management(Applied), Regulation, Zoning, Flood plain zoning, River basins.

Management of stormwater during 1973-1979 in DeKalb County, Georgia, with respect to political aspects is described. This county contains 30% of metropolitan Atlanta and the city of Decatur. It was the site of extensive development and flood plain encroachment prior to 1973. Although it was possible to pass development ordinances and zoning requirements that did not require county funds, only short-term projects showing immediate, visible results were of interest to some elections. ate, visible results were of interest to some elected officials. Projects with long-term, general benefits had limited appeal. It is suggested that benefits such as environmental protection, conservation, improved road transportation, better community image, and reduced damages to individuals will concern a broad base of the citizens, who can influence political bodies to implement a stormrater management program. (Cassar-FRC) W81-02118

FIELD MEASUREMENT OF TRANSVERSE DIFFUSION IN UNDIRECTIONAL FLOW IN A WIDE, STRAIGHT CHANNEL,

Loughborough Univ. of Technology (England). Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W81-02140

#### 2F. Groundwater

A MIXED NUMERICAL ANALYTICAL METHOD FOR GROUNDWATER FLOW SIM-ULATION.

IBM Scientific Center, Haifa (Israel).

D. Ramm, and D. Chazan. Water Resources Research, Vol 16, No 5, p 871-880, October, 1980. 10 Fig, 5 Ref.

Descriptors: \*Groundwater movement, \*Subsurface flow, \*Mathematical models, Aquifers, Equations, Wells, Inflow, Water pollution sources, Rivers, Springs, Salts.

ne is presented which permits the computa tion of the complex field behavior in an area which is densely populated with wells, using a coarse grid and a modest computational effort. This method is an efficient way to generate the information which an efficient way to generate the mornianon which will allow tracking of salt trajectories even in areas containing densely spaced wells because of the assumption that the flow is two dimensional. The method is a tool for solving flow equations, but may also be used to solve the flow problem and in the calibration of a model. A number of examples are presented which demonstrate the accuracy of the scheme. The scheme can be modified to take into account springs, rivers, phreatic aquifers, and multilayered aquifers. This scheme is of importance when a flow of pollutants must be determined in an area with many singularities. (Small-EDC) FRC) W81-01966

# VALIDITY OF CUBIC LAW FOR FLUID FLOW IN A DEFORMABLE ROCK FRACTURE,

P. A. Witherspoon, J. S. Y. Wang, K. Iwai, and J. E. Gale.

Water Resources Research, Vol 16, No 6, p 1016-1024, December, 1980. 9 Fig, 2 Tab, 18 Ref.

Descriptors: \*Geologic fractures, \*Stress, \*Flow, \*Mathematical studies, Hydrogeology, Flow measurement, Fluid mechanics, Flow characteristics, Geology, Fractures, Permeability, Porosity,

Results of a laboratory investigation of fluid flow in deformable rock are presented. Tension frac-tures were artificially induced in homogeneous samples of granite, basalt and marble, and flow tests under closed conditions were conducted. The investigations included both radial and straight flow geometries and covered apertures ranging from 250 to 4 micrometers. The cubic law for flow from 250 to 4 micrometers. The cubic law for flow in a fracture was confirmed repeatedly, regardless of loading path and frequency of loading process, open or closed fractures, or rock type. The con-trolling factor in fluid flow and permeability is the size of the fracture aperture. Slight changes in aperture can dominate any other change in the geometry of the flow field. (Titus-FRC)

# INSTABILITY IN AQUIFER IDENTIFICA-TION: THEORY AND CASE STUDIES,

Arizona Univ., Tucson. Dept. of Systems and In-

Artzona Oliv. 1, usas. Odustrial Engineering. S. Yakowitz, and L. Duckstein. Water Resources Research, Vol 16, No 6, p 1045-1064, December, 1980. 2 Fig. 15 Tab, 35 Ref.

Descriptors: \*Aquifer characteristics, \*Transmissivity, Analysis, \*Groundwater movement, Aquifers, Theoretical analysis, Hydrological properties, Head loss, Parametric hydrology, Algorithms, Mathematical studies, Measurement, Model

A discussion of measurement error in transmissivity estimates and aquifer identification schemes is presented, based on theoretical analyses and case studies. An aquifer simulation model was con-structed using best estimates of transmissivity and structed using best estimates of transmissivity and head. Transmissivity estimates were obtained both through programming and with an algebraic method which incorporated field parameters and discharge-recharge values. Radical changes in transmisvity values produced scarcely perceptible changes in head, revealing a problem of sensitivity in aquifer identification. In order for the error covariance to be within usable range the piezometric heads would have to be known to be within a few inches of accuracy. The accuracy problems in tric neads would nave to be known to be within a few inches of accuracy. The accuracy problems in the methods presented suggest that the problem of aquifer identification can not be properly addressed by existing models. Results imply that alternative methods such as multidimensional interpolation to estimate heads at unmeasured locations and nonparametric models may produce more useful information. (Titus-FRC) W81-01972

# THEORETICAL HEAD VARIOGRAMS FOR STEADY FLOW IN STATISTICALLY HOMO-

STEADY FLOW IN STATISTICALLY HOMO-GENEOUS AQUIFERS, Princeton Univ., NJ. Dept. of Civil Engineering. G. R. Chirlin, and G. Dagan. Water Resources Research, Vol 16, No 6, p 1001-1015, December, 1980. 10 Fig. 1 Tab, 22 Ref.

Descriptors: \*Aquifers, \*Groundwater movement, \*Transmissivity, Flow, Variability, Model studies, Aquifer systems, Boundaries, Hydrogeology, Rock properties, Aquifer characteristics, Head loss, Fluctuations, Statistical methods, On-site tests, Mathematical studies.

A model is presented which produces an expres-sion for the head variogram of an aquifer given a statistical description of the transmissivity field. The model assumes a steady, uniform average flow in a completely random medium of cylindical blocks whose size and transmissivity are independent. It employs the self-consistent model of flow physics. Limited available data prohibit greater refinement of the model at present. Results in a hypothetical case suggest that kriged standard denyponetical case suggest that kriged standard de-viation is overestimated perpendicular to the mean flow and underestimated parallel to it. The model has application in fitting typically inconclusive data points, and contributes to a technique which reduces scattering in plots of variograms from field data. (Titus-FRC) W81-01973

# MAPS SHOWING GROUNDWATER CONDI-TIONS IN THE HASSAYAMPA AREA, MARI-COPA AND YAVAPAI COUNTIES, ARIZONA--

Geological Survey, Tucson, AZ. Water Resources

For primary bibliographic entry see Field 7C. W81-02028

# LAND-SURFACE SUBSIDENCE IN THE TEXAS COASTAL REGION, Geological Survey, Austin, TX. Water Resources

K. W. Ratzlaff.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$3.50 in paper copy, \$6.00 in microfiche. Geological Survey Open-File Report 80-969, September, 1980. 19 p, 8 Fig. 24 Ref.

Descriptors: \*Land subsidence, \*Compaction, \*Groundwater, \*Overdraft, \*Texas, Aquifers, Water levels, Withdrawal, Oil reservoirs, Mining, \*Houston-Galveston area(TX).

Land-surface subsidence has been mapped in the Houston-Galveston area and is known to have occurred in other areas within the Texas coastal region. Most of the subsidence has been caused by both the withdrawal of groundwater and by the production of oil, gas, and associated groundwater. Land-surface subsidence was determined by com-

#### Water In Soils—Group 2G

paring adjusted elevations of bench marks for var-ious periods of releveling and by comparing topo-graphic maps of the same areas for different years. In general, most of the Texas coastal region has subsided less than 0.5 foot. The largest amount measured in the region is in the Pasadena-Houston Ship Changel area, where the land surface subsid-Ship Channel area, where the land surface subsided between 8.5 and 9.0 feet during 1906-73. The cause of the subsidence in this area was ground-water withdrawals. Local subsidence caused by sulfur mining in the Moss Bluff Salt Dome area has been reported to exceed 15 feet. In Jefferson oeen reported to exceed 15 feet. In Jefferson County, the Spindletop Dome area subsided ap-proximately 5 feet during 1925-77, and the Port Acres area subsided about 3 feet during 1959-77, mainly because of withdrawal of oil or gas and associated groundwater. Local subsidence caused by sulfur mining in the Spindletop Dome area has by surfur mining in the Spindietop Dome area has been estimated to exceed 10 feet. In southeastern Jackson County, the land surface subsided more than 1.5 feet during 1943-73 as a result of groundwater withdrawals. Withdrawals of oil, gas, and associated groundwater caused more than 5 feet of subsided groundwater caused more than 5 feet of subsided groundwater. dence during 1942-75 in the western part of Corpus Christi in Nueces County. (USGS) W81-02031

GROUNDWATER HYDROLOGY OF THE SA-GEBRUSH FLAT AREA AND POSSIBLE RE-LATIONS TO THE DISCHARGE OF RATTLES-NAKE SPRINGS, GRANT AND DOUGLAS COUNTIES, WASHINGTON,

Geological Survey, Tacoma, WA. Water Re-

sources Div. K. L. Walters.

K. L. Walters.

Available from the OFSS, USGS Box 25425, Fed.

Ctr., Denver, CO 80225, Price: \$4.00 in paper copy, \$3.50 in microfiche. Geological Survey Open-File Report 79-1530 (WRI), 1980. 27 p, 9 Fig, 3 Tab, 4 Ref.

Descriptors: \*Groundwater, \*Water wells, \*Aquifers, \*Surface-groundwater relationships, \*Washington, Hydrogeology, Well data, Water level fluctuations, Pumping, Groundwater movement, Chemical analysis, Hydrographs, Grant County(WA), Douglas County(WA).

In 1978, the U.S. Geological Survey, in coopera-tion with the State of Washington Department of tion with the state of washington Department or Ecology, investigated the hydrology of the Sage-brush Flat area as it relates to Rattlesnake Springs. Rattlesnake Springs and all known wells on Sage-brush Flat obtain water from basalt aguifers. The brush Plat obtain water from basant aquirers. The wells tap aquifers at or below the altitude of the spring discharge. Water levels in some wells on Sagebrush Flat, and in a well 27 miles to the northeast in an area of no groundwater development, show slight fluctuations that may correspond to annual variations in precipitation. However, hy-drographs of most wells on Sagebrush Flat show water-level declines and rises that correspond with the beginning and end of the pumping season. The discharge of Rattlesnake Springs started to decrease at about the beginning of the 1978 pumping season and did not start to increase until after most pumping was stopped. The water level in deep aquifers beneath Sagebrush Flat is at a lower altitude than in shallow a quifers, and water moves down well boreholes from shallow aquifers to deeper aquifers. This downward movement of water diverts groundwater that is moving toward natural discharge points such as Rattlesnake Springs, thereby decreasing the discharge at these points. (USGS) W81-02032

WATER-SUPPLY ASSESSMENT OF THE LAR-AMIE-FOX HILLS AQUIFER IN PARTS OF ADAMS, BOULDER, JEFFERSON, AND WELD COUNTIES, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div. For primary bibliographic entry see Field 4B. W81-02033

GROUNDWATER AVAILABILITY IN CAR-BONATE ROCKS OF THE DANDRIDGE AREA, JEFFERSON COUNTY, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.

Soulces Div.
E. F. Hollyday, and P. L. Goddard.
Geological Survey Open-File Repo
(WRI), 1980. 50 p, 22 Fig, 9 Tab, 8 Ref. Report 79-1263

Descriptors: \*Groundwater, \*Groundwater availability, Karst, Limestones, \*Tennessee, \*Carbonate aonity, Karst, Limestones, "Tennessee, "Caroonate rocks, Groundwater movement, Hydrogeology, Aquifer characteristics, Natural recharge, Water wells, Water yield, Physical properties, Hydrologic data, "Jefferson County(TN), Valley and gic data, \*Jetterson Coun. Ridge physiographic province.

Groundwater in Jefferson County, Tenn., occurs in solution openings that follow bedding planes and strike joints in the dense limestone and dolo-mite. Recharge beginning at topographic highs in the northwest moves across strike to lows in the southeast; it is intercepted and collected by high permeability beds in the middle of the Knox Group and is routed along strike to discharge at large springs. Exploratory wells were drilled at two sites to test this concept of the flow system. Three wells at Moore Spring site in the recharge area penetrated only mud and solid rock. Four wells at Riley spring site in the discharge area each penetrated at least five water-bearing openings that gave these wells an average production of 93 gallons per minute and a maximum of 180 gallons per minute. (USGS) W81-02034

GROUNDWATER MODELS FOR WATER RE-SOURCES PLANNING, Geological Survey, Reston, VA. Water Resources

Div. J. E. Moore.

Geological Survey Open-File Report 80-581, 1980. 22 p, 11 Ref.

Descriptors: \*Groundwater resources, \*Computer models, \*Model studies, \*Planning, Analog models, Groundwater movement, Mathematical models, Groundwater movement, Mantematica models, Water resources development, San Luis Valley(CO), Arkansas River Valley(CO), Rocky Mountain Arsenal(CO), Southwest Florida, Fore-casting, Groundwater availability, Water quality.

In the past decade hydrologists have emphasized the development of computer-based mathematical models to aid in the understanding of flow, the transport of solutes, transport of heat, and deformation in the groundwater system. These models have been used to provide information and predictions for water managers. Too frequently, ground-water was neglected in water-resource planning because managers believed that it could not be adequately evaluated in terms of availability, quality, and effect of development on surface water supplies. Now, however, with newly developed digital groundwater models, effects of develop-ment can be predicted. Such models have been used to predict hydrologic and quality changes under different stresses. These models have grown in complex flow models to three-dimensional simulations of groundwater flow which may include solute transport, heat transport, effects of land subsidence, and encroachment of salt water. This paper illustrates, through case histories, how predictive groundwater models have provided the information needed for the sound planning and management of water resources in the United States. (USGS) W81-02035

HYDROLOGY OF THE SELDOVIA AREA, ALASKA, Geological Survey, Anchorage, AK. Water Re-

sources Div. G. L. Nelson, and W. R. Danskin.

G. L. Netson, and W. R. Danskin. Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$3.50 in paper copy, \$1.00 microfiche. Geological Survey Open-File Report 80-952 (WRI), 1980. 2 Sheets, 5 Fig, 2 Tab, 5 Ref.

Descriptors: \*Hydrogeology, \*Groundwater, \*Surface waters, \*Water resources, \*Alaska, Glacial drift, Aquifers, Water wells, Water pollution

sources, Streamflow, Water utilization, Chemical sis, \*Seldovia area(AK).

Surficial materials in the Seldovia area, Alaska, are Surficial materials in the Seldovia area, Alaska, are mapped as glacial drift over sedimentary bedrock, glacial drift over igneous and metamorphic bedrock, valley-bottom, alluvium, alluvial fan deposits, beach and intertidal deposits, and peat. Unconsolidated materials are generally less than 10 feet thick except in well-drained glacial deposits along the Seldovia-Jakolof Bay Road and in depressions in the bedrock surface. These depressions are poorly drained and commonly contain peat bogs. Development of domestic wells (1-15 gallons per minute) may be possible from unconsolidated materials and sedimentary bedrock, but larger water requirements must be met from surface-water sources. In areas having the water table or top of bedrock at ments must be met from surface-water sources. In areas having the water table or top of bedrock at shallow depths, effluent from sewage disposal sys-tems may cause pollution of the land surface and nearby surface water. Seepage from hillside aquifers and unstable land along the coast of Ka-chemak Bay may adversely affect roads and structures. (USGS) W81-02037

#### 2G. Water In Soils

SURVEY OF METHODS FOR SOIL MOISTURE DETERMINATION,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. T. J. Schmugge, T. J. Jackson, and H. L. McKim. Water Resources Research, Vol 16, No 6, p 961-979, December, 1980. 13 Fig, 2 Tab, 169 Ref.

Descriptors: \*Soil moisture, \*Remote sensing, \*Measurement, Application methods, Soil physics, Moisture content, Subsurface waters, Evapotranspiration, Evaporation, Instrumentation, Hydrological cycle, Transpiration, Methodology, Testing procedures, On-site tests, Analytical techniques

A survey of methods for determining soil moisture is presented. The three general approaches are in situ or point measurements, soil water models, and remote sensing. All methods should meet three requirements: frequent observations, an estimate of moisture within the top 1-2 meters of soil, and a description of moisture variations over a large expanse, such as a county or state. In situ methods include gravimetric, nuclear and electromagnetic techniques. These are only accurate at the point of measurement and would require considerable man-power. Soil water models are based on meteoro-logical parameters including precipitation and eva-portranspiration. These methods provide fast anpotranspiration. I nese metiods provide last an-swers for large areas, but require costly data which can be difficult to obtain and can introduce error into the models. Remote sensing uses solar, ther-mal infrared, and microwave radiation. It offers rapid data collection over large areas on a repet-itive basis. However, spatial resolution and cost are limitations. An integrated system of soil moisture determination which combines various approaches is suggested as the most cost-effective and informative method. (Titus-FRC) W81-01970

A SIMPLIFIED FUNCTIONS APPROACH FOR DETERMINING SOIL HYDRAULIC CONDUC-TIVITIES AND WATER CHARACTERISTICS IN SITU.

Hawaii Univ., Honolulu. Water Resources Re-search Center.

search Center. L. R. Ahuja, R. E. Green, and S-K. Chong. Water Resources Research, Vol 16, No 5, p 947-953, October, 1980. 17 Fig. 16 Ref. OWRT-B-054-

Descriptors: \*Theoretical analysis. movement, Watersheds, Drainage, Model studies, Mathematical models, Darcy's law, Groundwater movement, \*Hydraulic conductivity, Soil mois-

In order to determine the hydraulic conductivity and soil water content of a watershed soil from minimum in situ field measurements, it was as-

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sumed that the former was a piecemeal power form and the latter a linear logarithmic function of the soil water suction. The values of these functions were measured by analysis of drainage phase tensiometric data plus field values of near saturated conductivity and one sampling of soil moisture during drainage. The theory set forth allows the calculation of the unsaturated hydraulic conductive and diffusivity in the price heaveled of ity and diffusivity without the prior knowledge of soil water features which is required for Darcian soil water leatures which is required for Darcian analysis, a more rigorous method. The model was applied to field measurements taken on four Hawaiian soils and one California soil with generally satisfactory results. In some instances where there satisfactory results. In some instances where there were differences in the conductivity values for very small suctions, the discrepancies were attributed to field measurement errors or the use of soil core water characteristics for the very wet region in the Darcian system. Although the slope parameter of the water characteristic function was more sensitive to the scatter in the input data, the overall simplified method seemed promising for use in computing soil water content and saturated hy-draulic conductivity. (Geiger-FRC) W81-01999

RAIN INFILTRATION INTO LAYERED SOILS:

PREDICTION, Mosul Univ. (Iraq). Dept. of Irrigation Engineer-

ing. A. Y. Hachum, and J. F. Alfaro.

Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil En-gineers, Vol 106, No IR4, p 311-319, December, 1980. 2 Fig. 2 Tab, 15 Ref.

Descriptors: \*Wetting, \*Rainfall, \*Mathematical models, Infiltration, Soil moisture, Soil water movement, Hydrologic properties, Irrigation, Nonuniform soils, \*Layered soils.

The Green-Ampt approach for describing vertical infiltration into nonuniform soils is extended to rain applications. The model contains three measurable input parameters which are based on properties and initial soil profile conditions. Darcy's law is combined with the continuity principle subjected to the assumptions of a sharp abrupt wetting front, a constant hydraulic conductivity in the wetted a constant hydraulic conductivity in the wetted zone, a constant water pressure head at the wetting front, and negligible effect of raindrops in the infiltration process. Model performance was com-pared to results with a second model derived from general flow theory, and good agreement was found. Results are compared for different soil pro-files and rain intensities. Numeric examples are given. The conditions under which soil surface given. The conditions under which soil surface saturation and water ponding occur are examined The model is shown to be a useful, workable tool in irrigation and hydrology to approximate infiltration in soils which are not uniform. (Small-FRC) W81-02092

AN IMPROVED PROCEDURE FOR MEASURING WATER RETENTION CURVES AT LOW SUCTION BY THE HANGING-WATER-COLUMN METHOD,

Volcani Inst. of Agricultural Research, Bet-Dagan

P. Berliner, P. Barak, and Y. Chen. Canadian Journal of Soil Science, Vol 60, No 3, p. 591-594, August, 1980. 3 Fig, 4 Ref.

Descriptors: \*Instrumentation, \*Retention, Soil water, Soil physical properties, Soil texture, Soil moisture, Soil water movement, Soil-water-plant relationships, Evaporation, Water retention, \*Soil moisture retention, \*Israel.

An improved method for measuring soil water retention curves at low suction levels of 0-300 retention curves at low suction levels of 0-300 mbar by the hanging-water-column technique is described. The procedure involves weighing the released water without disconnection of the cell from the tubing, resulting in a level of precision of + or - 0.01 g water. Errors from volumetric changes due to evaporation are avoided, and equilibrium at each point is attained with ease. The librium at each point is attained with ease. The apparatus consists of a balance, a fritted glass funnel, flexible latex tubing and a glass Mariotte tube that is lowered to produce a hanging water

column. Three soils from Israel were analyzed by conventional equipment and the new device, and the retention curves obtained by the two methods were compared. Good agreement was obtained in triplicate trials performed by the present technique, as well as between these results and those obtained by the conventionally used procedure. (Geiger-FRC) W81-02147

#### 2H. Lakes

SOME CONSIDERATIONS ON THE DENSE POPULATION OF A PURPLE SULFUR BAC-TERIUM, CHROMATIUM SP. AT THE MID-DEPTH OF LAKE KAIIKE,

Nagasaki Univ. (Japan). Faculty of Fisheries. M. Matsuyama.

Japanese Journal of Limnology, Vol 41, No 2, p 84-94, April, 1980. 8 Fig, 27 Ref.

Descriptors: \*Bacteria, \*Sulfur bacteria, \*Lakes, \*Stratification, \*Chromatium sp, Hydrogen sulfide, \*Lake Kaiike(Japan), Japan, Reduction(Chemical). Aquatic bacteria, Algae, Aquatic plants, Light penetration, Aquatic environment, Phosphorus compounds, Nitrogen compounds, Nutrients, Light intensity, Aphotic zone, Penetration.

A dense population, 5 million cells per ml, of a purple sulfur bacterium, Chromatium sp., was found in a thin horizontal layer at mid-depth, 4.75 meters, in the small stratified lake, Lake Kaiike, Kamikoshiki Island, Japan. Although this bacterium grows more slowly than algae, it uses the inorganic nutrients and hydrogen sulfide produced in the deeper water, permitting little nutrient material to rise into the upper layers for utilization by algae. Light attenuation studies showed that the bacterial plate significantly decreases light availa-ble below it. The layer of water beneath the bacteria was in a reducing condition, containing hydro-gen sulfide at a maximum level of 19 mg S per liter at 5.5 meters depth and no dissolved oxygen below 4.75 meters. (Cassar-FRC) W81-01977

#### CHANGES IN PHOSPHORUS CONCENTRA-TIONS DUE TO MIXING BY MOTORBOATS IN SHALLOW LAKES.

University of Central Florida, Orlando. Engineering and Industrial Experiment Station.

Y. A. Yousef, W. M. McLellon, and H. H. Zebuth Water Research, Vol 14, No 7, p 841-852, July, 1980. 9 Fig, 8 Tab, 22 Ref.

Descriptors: \*Phosphorus, \*Lakes, Chlorophyll, Boating, Productivity, Recreation, Turbidity, Dis-solved oxygen, Statistical methods, Hydrogen ion concentration, Florida, Water quality, Mixing, Shallow water, Motorboats, Effects.

Changes in water quality due to mixing by motor-boats were studied in shallow lakes of Central Florida. The three lakes, Lakes Claire, Mizell and Jessup, differed in average water depth, sediment characteristics and trophic state. Significant increases in turbidity and ortho- and total phosphorus concentrations were demonstrated in water samples collected after mixing by motorboats in Lakes Claire and Jessup. The results obtained from Lake Mizell were not as conclusive. The increase in the orthophosphorus content for Lakes Claire, Mizell and Jessup averaged 43, 16, and 73%; the increase in total phosphorus content for the same three lakes was 39, 28, and 55%. Positive correlations existed between turbidities and the phosphorus content in the water column. The authors also demonstrate that the rate of increase in the phos-phorus content with mixing time is much higher than the rate of decline after cessation of mixing. Data indicated substantial water quality effects are possible due to recreational boating on shallow lakes. (McKeon-FRC) W81-02007

#### 2I. Water In Plants

SOYBEAN ROW SPACING AND SOIL WATER SUPPLY: THEIR EFFECT ON GROWTH, DE-VELOPMENT, WATER RELATIONS, AND MINERAL UPTAKE,

W. K. Mason, H. M. Taylor, A. T. P. Bennie, H. R. Rowse, and D. C. Reicosky.

Science and Education Administration, Peoria, Illinois. Advances in Agricultural Technology Report AAT-NC-5, November, 1980. 63 p, 11 Fig, 33 Tab, 36 Ref

Descriptors: \*Soybeans, \*Irrigation effects, \*Planting management, Field crops, Agronomy, Solar radiation, Plant growth, Biomass, Nutrients, Moisture stress Soil moisture

The growth, development, water and nutrient use, and yield were monitored for soybeans grown in wide (1.0m) and narrow (0.25m) rows under irrigated and nonirrigated conditions to clarify why narrow row soybeans often produce greater yields. Irrigation increased plant height, leaf area, and biomass production and slowed both vegetative and reproductive development. Planting soybeans in 1.0m rows rather than 0.25m rows increased in 1.0m rows rather than 0.25m rows increased plant height, biomass production and pod number, and speeded reproductive development. The more even canopy distribution of the narrow rows resulted in greater radiation interception. With the significant increases in biomass production caused the production and wide recommending the first leader. significant increases in biomass production caused by irrigation and wide row spacing, the final seed yield results are somewhat surprising. The 0.25m row spacing significantly outyielded the 1.0m row spacing, and irrigation had no significant effect on yield except to reduce seed size. No effect of row spacing on total leaf water potential or osmotic potential was found under irrigated or nonirrigated conditions. Results indicate that yield in the irrigated plots was limited by low rediction leaves. conditions. Results indicate that yield in the irrigated plots was limited by low radiation levels, by low temperatures, or both, just before maturity, and the 0.25m rows outyielded the 1.0m rows because of greater late-season solar radiation interception. (Moore-SRC) W81-01942

#### LINEARIZED MOISTURE FLOW WITH ROOT EXTRACTION FOR THREE DIMENSIONAL, STEADY CONDITIONS.

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.

A. W Fard. W. Warrick, D. O. Lomen, and A. Amoozegar-

Soil Science Society of America Journal, Vol 44, No 5, p 911-914, September/October, 1980. 4 Fig, 1 Tab, 11 Ref. OWRT-B-064-ARIZ(5).

Descriptors: \*Soil-water-plant relationships, \*Irrigation systems, Unsaturated flow, Soil moisture, Equations, Trickle irrigation, Moisture, Soil water

A mathematical model is presented to simulate A mathematical model is presented to simulate plant water uptake in situations such as trickle irrigation. Geometries considered have radial symmetry and include matrix potentials for points, discs, and cylinders. The cylinder solution is new. Assumptions include a hydraulic conductivity ex-Assumptions include a nydraulic conductivity ex-ponentially related to pressure head, uniform soil, and negligible evaporation loss. Four examples are given to illustrate source-sink combinations: cylin-der, buried disc, damped cylinder, and double cyl-inder. (Cassar-FRC) W81-01998

#### 2J. Erosion and Sedimentation

THE DISTRIBUTION OF KINETIC ENERGY OF RAINFALL IN SOUTH AFRICA - A FIRST

ASSESSMENT,
Natal Univ., Pietermaritzburg (South Africa).
Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2B. W81-01957

#### Saline Water Conversion—Group 3A

TRAP EFFICIENCY STUDY, HIGHLAND CREEK FLOOD RETARDING RESERVOIR NEAR KELSEYVILLE, CALIFORNIA, WATER YEARS 1966-77.

Geological Survey, Menlo Park, CA. Water Resources Div.

L. F. Trujillo.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$3.75 in paper copy, \$3.50 in microfiche. Geological Survey Open-File Report 80-735, July, 1980. 25 p, 7 Fig. 8 Tab. 12 Ref.

Descriptors: \*Trap efficiency, \*Detention reservoirs, \*Sediments, \*California, Inflow, Discharge(Water), Water storage, Sediment transport, Particle size, Chemical analysis, Lake County(CA), Kelseyville(CA), Highland Creek Reservoir(CA).

This investigation is part of a nationwide study of trap efficiency of detention reservoirs. In this report, trap efficiency was computed from reservoir inflow and outflow sediment data and from reservoir survey and outflow data. Highland Creek Reservoir is a flood retarding reservoir located in Lake County, near Kelseyville, California. This reservoir has a maximum storage capacity of 3,199 acre-feet and permanent pool storage of 921 acre-feet. Mean annual rainfall for the 14.1-square-mile drainage area above Highland Creek Dam was 29 inches during the December 1965 to September 1977 study period. Resultant mean annual runoff was 17,100 acre-feet. Total reservoir inflow for the 11.8-year study period was 202,000 acre-feet, transwas 17,100 acre-feet. Total reservoir inflow for the 11.8-year study period was 20,2000 acre-feet, transporting an estimated 126,000 tons (10,700 tons per year) of suspended sediment. Total reservoir outflow for the same period was 188,700 acre-feet, including 15,230 tons (1,290 tons per year) of sediment. Estimated trap efficiency for the study period was 88%, based on estimated sediment inflow and measured sediment outflow. Reservoir surveys made in December 1965 and April 1972 revealed a storage capacity loss of 35.8 acre-feet during the 6.3-year period. Computed by using an estimated specific weight, this loss represents 54,600 tons of deposited sediment. Sediment outflow during the same period was 8,890 tons. Trap flow during the same period was 8,890 tons. Trap efficiency for the survey period was 86%. (USGS) W81-02030

#### SUBMERGED HORIZONTAL JET OVER ERODIBLE BED.

Jalpaiguri Government Engineering Coll. (India).

S. S. Chatterjee, and S. N. Ghosh.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY11, p 1765-1782, November, 1980. 9 Fig, 2

Descriptors: Velocity, \*Stream erosion, \*Flow, Hydraulics, Jets, Erosion, \*Sediment transport, Al-luvium, Shear, Boundary processes, Sediments, Friction, Geomorphology, Mathematical studies, Rates, Diffusion, Sands.

An experimental investigation of sediment trans-An experimental investigation of sediment trans-port due to horizontal jet flow over erodible sand and gravel beds is discussed. Test runs of jet flows were undertaken with two erodible beds with dif-ferent grain size distributions. Using the data, the shear stress acting over the bed during the devel-opment of a scour hole was evaluated, and sedirement of a scori noise was evaluated, and experi-ment transport was computed. From the experi-mental data the velocity distribution law within the boundary layer and the expression for the growth of its thickness with distance have been derived. An expression for critical shear stress was derived. At the location of maximum scour an expression for the pressure-shear relationship for a Preston tube was obtained. Results indicate that the effect of grain-size characteristics of the bed material on the development of boundary shear is increasingly felt as the equilibrium stage is approached. The growth and thickness of the boundary layer have been found to be dependent on the flow depth, grain size, and distance from the sluice opening. There is discrepancy between values calculated for the sand bed, but there is good agreement of values for the gravel bed. (Titus-FRC) W81-02079

2L. Estuaries

AN ASSESSMENT OF STORM SURGE MOD-ELING. Water Resources Council, Washington, DC.

Report, 1980. 43 p, 43 Ref.

Descriptors: \*Storm surges, \*Model studies, \*Hurricanes, Computer models, Surges, Coasts, Floods, Mathematical models, Storms, Oceans, Meteorological data, Hydrodynamics, Forecasting.

Of the many phenomena affecting the coastlines of the United States, storm surges cause the greatest damage. Techniques for accurately estimating storm surge water levels are essential to the disstorm surge water levels are essential to the dis-semination of information to warn people of storm surges, to the design of coastal protective works, and to the reduction of economic loss and human suffering. Several numerical models are currently being used to estimate hurricane-produced storm surges, with each model having its own advocates surges, with each model having its own advocates and sphere of application. Open coast storm surge models, including the SPLASH Model, SSURGE Model, FIA Model, and BATHYSTROPHIC Model, were reviewed. A detailed model assessment was not possible, but the initial review indicated that: some models had not been adequately tested; adequate data for testing was not readily available; and the models were sufficiently different that direct comparison of algorithms could not be made. Specific recommendations which would provide the basis for a decision on the use of a particular model and could be used in future standardization efforts include: model documentation; the decoupling of storm and surge models; model calibration and verification; model selection based on simulations of historic data, sensitivity studies, on simulations or instortic data, sensitivity studies, and economics of model application; consideration of inland flooding and extra tropical storm modeling; and the development of a permanent system for the collection, storage, and retrieval of meteorological and surge data. (Moore-SRC) W81-01935

MATHEMATICAL MODELING OF CIRCULA-TION IN BAKER BAY, WASHINGTON/ TION IN OREGON,

Washington State Univ., Pullman. Dept. of Civil

washington state Univ., Fulliman. Dept. of Civil and Environmental Engineering.

J. A. Roberson, H. D. Copp, and B. Naik.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-177693, Price codes: A66 in paper copy. A01 in microfice. Technical Report HY-4/80, September 30, 1980. 106 p, 19 Fig, 1 Tab, 13 Ref, 2 Append. OWRT-A-099-WASH(1), 14-34-0001-9051.

Descriptors: Computer modeling, Hydraulics, \*Estuaries, \*Bays, \*Water circulation, Forecasting, \*Baker Bay, Washington, Oregon, Model studies, \*Tidal effects, \*Sedimentation, Mathematical models, Columbia River.

A two-dimensional, vertically averaged, mathmodel was developed to simulate hydrau-lic circulation of Baker Bay at the mouth of the Columbia River in Washington/Oregon. An existing model was modified so shoal areas that become ing model was modified so shoal areas that become exposed during low tides would be created realistically during simulation. Baker Bay is bounded on the south of the Columbia River with two islands along this boundary. The initial conditions for a given run are the tide level and velocity (zero) for flood tides. The model must be run one complete tide cycle before circulation predictions in the bay are representative of the actual circulation. Com-parison of computed velocities and depths with rather meager field data indicates the model per-forms adequately. The model was used to examine certain possible modifications to the bay at the boundary with the Columbia River to assess how bay circulation might change. Sediment deposition has restricted movement of commercial ships and pleasure craft into and out of the bay; more intense circulation velocities would help to maintain adequate depths in ship channels and in the bay generally. Modifications examined influenced internal circulation only slighly but some showed promise of improving velocities locally in existing channels the bay/river boundary. Additionally, more

detailed investigations are needed prior to undertaking remedial works. W81-02010

WATER QUALITY IN RHODE RIVER AT WATER QUALITY IN RHODE RIVER AT SMITHSONIAN INSTITUTION PIER NEAR ANNAPOLIS, MARYLAND, JANUARY 1976 THROUGH DECEMBER 1978,

Geological Survey, Edgewater, MD. Water Resources Div. For primary bibliographic entry see Field 5A. W81-02040

TIDAL AND DIEL FLUCTUATIONS IN THE TEMPORAL CONCENTRATIONS OF CHLOROPHYLL A AND PHEOPHYLIN AT A STATION MONITORING A HIGH-MARSH CREEK.

South Carolina Univ., Columbia. Dept. of Biology. C. W. Erkenbrecher, Jr., and L. H. Stevenson.

Journal of Experimental Marine Biology and Ecology, Vol 48, No 3, p 253-261, December, 1980. 4 ogy, Vol 48, No 3, Fig, 3 Tab, 14 Ref.

Descriptors: \*Estuaries, \*Diel migration, \*Phyto-plankton, Sampling, Tidal effects, Chlorophyll, Pheophytin, Temporal distribution, Solar radi-ation, Fluctuations, Variability, Water level fluctu-ations, Oyster Landing Creek, South Carolina, Pig-ments, Plant pigments, Marine biology.

Pheophytin level fluctuations in a high-marsh creek were strongly influenced by tides; chloro-phyll a concentrations were affected by complex, superimposed tidal and diel rhythms. Sampling done in Oyster Landing Creek, North Inlet Estu-ary, South Carolina, during May, June, August, and October showed a mean chlorophyll a concentration of 3.02 mg per cu meter (range 0.13 to 11.44) and pheophytin, 1.77 (range 0.01 to 8.49). During May and June solar radiation caused marked increases of chlorophyll a during the day, peaking at mid-afternoon. Pheophytin levels were not similarly affected, but were correlated with the tides, minimum at high tide and maximum at low tide. Both pheophytin and chlorophyll a had a tide. Both pheophytin and enfortophyil a had a negative correlation with water depth. Therefore, tidal cycles and sampling dates are factors in planning the sampling of phytoplankton for species composition, productivity, and seasonal effects. (Cassar-FRC) W31-02076

CONTRIBUTION OF MARINE ALGAE TO TRIHALOMETHANE PRODUCTION IN CHLORINATED ESTUARINE WATER, Environmental Research Lab., Johns Island, SC. Bears Bluff Field Station.

For primary bibliographic entry see Field 5B. W81-02131

#### 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

#### 3A. Saline Water Conversion

DESALINATION: A PRACTICAL PROCESS. National Inst. of Water Research, Pretoria (South Africa).

Imiesa (Johannesburg), Vol 4, No 5, p 43, 45, 47, May, 1979. 2 Fig, 2 Tab.

Descriptors: \*Desalination, \*Desalination processes, \*Distillation, \*Electrodialysis, \*Reverse osmosis, Freezing, Ion exchange, Membrane processes, Solar distillation, Energy requirements, Vapor compression distillation, Demineralization, Water purification, Brackish water, Saline water, Multistage flash evaporation.

Despite technological advances and the improved efficiency of desalination processes, the cost of desalination will continue to rise due to increasing energy and materials costs, making desalination

#### Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

#### Group 3A-Saline Water Conversion

desirable only when water from conventional sources is unavailable or extremely expensive. Distillation is the oldest and most widely used desailnation process, accounting for 78% of the total world capacity. Types of distillation include multistage flash evaporation, vapor compression, and solar distillation. Freezing is also recognized as a desalination process but many problems remain unsolved and the process is not yet technically or economically viable. Electrodialysis accounts for about 3% of the total world desalination capacity, however, it suffers from membrane fouling norty. desirable only when water from conventional about 5% of the total world desamation capacity, however, it suffers from membrane fouling problems. Reverse osmosis represents 17% of the world capacity and offers low energy requirements and is capacity and others low energy requirements and is restricted to the preparation of boiler feed water from brackish water. The salinity of the water to be treated greatly effects the energy requirements and efficiency of the various processes. Efforts must be made to prevent the mineralization of water so that expensive desalination processes will not be increasingly needed. (Seigler-IPA) W81-02053

#### 3D. Conservation In Domestic and Municipal Use

PERCEPTION OF WATER QUALITY IN SOME VILLAGES OF THE SAVANNA ZONE

SOME VILLAGES OF THE STATE OF NIGERIA, Ibadan Univ. (Nigeria). Dept. of Geography. F. O. Akintola, C. Acho-Chi, and S. Mark. Water Supply and Management, Vol 4, No 4, p 243-252, 1980. 2 Fig. 6 Tab, 5 Ref.

Descriptors: \*Water quality, \*Rural areas, Water supply, Surveys, Water resources development, Public health, Future planning, Water manage-ment, Social aspects, Human diseases, Potable water, \*Nigeria.

The water quality and supply situation of three villages of rural Savanna Nigeria were examined, particular efforts were made to assess the bitants' perception of water quality to aid in innabitants perception of water quanty to ad in the future planning of rural water supply programs. Results showed the quality of the water to be generally poor; often drinking water supplies were boiled, as the same water source may have been used for wading or laundering. There was a high incidence of water-borne diseases. The shorthigh incidence of water-borne diseases. The shortage of water was most prevalent during the dry season when ponds and wells, the major water sources, were very shallow. Villagers spent many hours each day fetching water from distant supply wells for domestic use. The people studied showed a keen awareness of water quality and used water from different sources for different purposes. It was recommended that the government provide more pipe-borne water supplies, wells, and boreholes to increase water supply and quality. The villagers are being encouraged to locate bathrooms, latrines, and laundry facilities far from drinking supplies. Education of the populace is also suggested to impress upon the people the value of suggested to impress upon the people the value of good quality water to their personal health and hygiene. (Geiger-FRC)

A COST-BENEFIT ANALYSIS OF WATER USE RESTRICTIONS, Johns Hopkins Univ., Baltimore, MD.

S. H. Hanke. Water Suppl

Water Supply and Management, 269-274, 1980. 1 Fig. 1 Tab, 5 Ref. and Management, Vol 4, No 4, p

Descriptors: \*Mathematical models, \*Cost-benefit analysis, Model studies, Water utilization, Water demand, Water conservation, Marginal costs, Consumptive use, Water costs, Droughts, Water shortage, \*Australia, Perth(Australia)

A mathematical formula for determining cost-benefit values for water use restriction programs is presented. Data obtained on water use in Perth, Australia, for 1975-1976 are employed to test the utility of the model during periods corresponding to drought conditions when water use curtailments would have been in operation. The equations set forth are based on the assumption that a policy which yields incremental benefits greater than its incremental costs is a desirable policy and should be adopted. Calculations of marginal water costs using the model were conducted under conditions of restricted and non-restricted use. Four rules were deduced from data generated by the study concerning the economics of water use restrictions It was concluded that water use restrictions would be uneconomical if prices were set equal to or above marginal costs. The restriction of water use according to the model would always be economical if prices were set below marginal costs and if restrictions did not reduce consumption below its proper level. Another rule of the model held that water use restrictions may or may not be economi-cal if prices were set below marginal costs and if restrictions reduced consumption below its proper level. (Geiger-FRC) W81-01952

DOMESTIC WATER METERS IN SOUTH AFRICA, R. M. Burle

Municipal Engineer (Johannesburg), Vol 10, No 3, p 27, May/June, 1979.

Descriptors: \*South Africa, Measurement, \*Water metering, \*Water conservation, Low flow, Water consumption, Accuracy, Design criteria, Domestic water, Cost effectiveness, Water loss, Leakage, Design criteria, Water meters.

South Africa is experiencing high water metering costs, large water losses, and poor control over its water due to the incompatibility between meter design and actual installation conditions. Strict design and actual installation conditions. Strict Assize regulation generally specify the use of a positive displacement type of meter in the form of a positive rotary piston meter. These meters are highly accurate under 'ideal' conditions. 'Ideal' conditions seldom exist due to factors including the use of the smallest possible meter for homes to restrict water use, rising living standards and inrecreased water consumption, and dissolved solids and grit particles in the water. To counter this problem, meter design should take into account adverse installation conditions. This will, in time, allow meter design to reflect long-term cost considerations. (Seigler-IPA) W81-02046

ENERGY AND WATER CONSERVATION RE-SEARCH AND THE LOCAL AUTHORITY, National Building Research Inst., Pretoria (South

Africa). T. L. Webb.

Imiesa (Johannesburg), Vol 4, No 6, p 37, 39, 41, June, 1979. 2 Fig.

Descriptors: \*South Africa, \*Water conservation, \*Energy conservation, \*Engineering personnel, Training, Building codes, Fossil fuels, Human pop-ulation, Solar energy, Energy resources, Plumbing, Information dissemi nation

Local town and city engineers can facilitate energy and water conservation efforts in the following ways: by applying and incorporating research find-ings in the areas under their control, by assisting and collaborating with research activities, and by disseminating the information gained from research. Local South African engineers are responsible for the services of 80% of the country's people and in this position they can directly aid in energy and water conservation. To achieve energy conservation of fossil fuel resources, the amount energy used must be reduced and replaced by alternative, preferably renewable, energy sources. Three courses of action are complementary to this reduction: education of policy makers and the public, implementation of economic measures to promote conservation, and legislation to enforce conservation measures. South Africa's National Building Research Institute is guiding research areas so that the results will be meaningful and practical. (Seigler-IPA) W81-02047

URBAN WATER ECONOMY: A MASTER

National Building Research Inst., Pretoria (South Africa). P. R. Crabtree

Imiesa (Johannesburg), Vol 4, No 5, p 27-29, 31, 65, May, 1979. 1 Fig.

Descriptors: \*South Africa, \*Water conservation, "Municipal water, Water closety Urinals, "Plumb-ing, Cities, Urbanization, Economic efficiency, Measurement, Toilets, Water utilization, Leakage, Swimming pools, Pressure reduction.

The South African Bureau of Standards and the The South African Bureau of Standards and the Water Research Commission have organized a project to study the design and usage of water supply fittings and to establish criteria for the National Building Regulations in an effort to promote water savings and conservation. This project is bested. is based on the concept that water-closets and urinals have the greatest potential for reducing water consumption in buildings. Once building specifications have been determined, an approved specinications may been determined, an approved system will be enacted to ensure that only fittings and appliances of acceptable standards are used. Codes of practice will be drawn up for plumbing and drainage in buildings; for gardens, parks, and recreational facilities; and for municipal water distribution systems. Block metering as well as individual flat metering are being studied for their conservation potential and accuracy. Pressure reduction is another conservation technique being studied. Other areas under investigation include the design of baths and basins, leakage reduction, and water consumption in private swimming pools. The need for a campaign to generate public awareness of the need for water conservation is also recognized. (Seigler-IPA)
W81-02063

THE EFFECT OF METERING ON URBAN WATER CONSUMPTION,

Durban City Engineer's Dept. (South Africa). D. C. Macleod

Municipal Engineer (Johannesburg), Vol 10, No 3, p 23-26, May/June, 1979. 1 Fig, 5 Tab.

Descriptors: \*South Africa, Measurement, Water demand, \*Water costs, \*Water conservation, Instrumentation, Water consumption, Capital costs, Leakage, Tariffs, Urbanization, Cities, Water supply, Water rates, Water utilization, \*Water metering, \*Purban.

A Universal Metering Program was initiated in Durban, South Africa, in 1971 and results show an actual consumption level 40% less than the expected level of consumption. The Durban water supply system serves not only the 751,265 residents of the city itself, but it also serves numerous other areas which lie within a 27 km radius of the city. Since 1971, 61,014 meters have been installed at a R2,262,863. Including out-of-city meters, there are now a total of 74,962 metered connections. Due to problems with meter size and quality, specification for meters have been issued. Three basic tariffs are applied, an in-city tariff, an out-of-city tariff, and some special bulk agreements. The large drop in consumption was not all due to metering, the eco-nomic recession had an additional depressing effect. Although the capital cost of the metering program was high, it was still less than would have been needed to expand water conservation and purification works to meet higher demands. Also, the metering cost is offset by the ability to detect serious leakage. Since consumers have adjusted to paying for water, the rate of growth of demand has returned to nearly the rate seen before the metering program. (Seigler-IPA) W81-02066

#### 3F. Conservation In Agriculture

SNOWFALL AND ITS POTENTIAL MANAGE-MENT IN THE SEMIARID CENTRAL GREAT

Science and Education Administration, Akron, CO. Central Great Plains Research Station. B. W. Greb.

Science and Education Administration, Oakland, California, Agricultural Reviews and Manuals

ARM-W-18, December, 1980. 50 p, 10 Fig, 24 Tab,

Descriptors: \*Great Plains, \*Snow management, \*Water conservation, Semiarid climates, Snow surveys, Vegetation effects, Windbreaks, Snowmelt, Strip cropping, Winds, Wheatgrasses, Snowpacks, Crop production, Irrigation water.

In 1955, investigations were initiated at Akron, Colorado, to monitor snowfall events, to estimate the contribution of snowmell to crop production, and to design practical systems to trap and hold wind-transported snow for water conservation. For 24 winters, measurable snowfall occurred an average of 12 times per season, totaling 32 inches of cumulative snowfall, which contained 11.9% water and averaged 3.82 inches precipitation. Seasonal variations were sometimes extreme. Data are given for storm-size distribution, snowfall by months, snowfall during the nonfrozen soil period, and the characteristics of wind-transported snow-fall. Sufficient snowfall and water intake of snowmelt from drifted snow occurs to justify developing snow management systems. Snow manager systems tested involved the use of short-height woodslat fences of various air porosities, grass woodstat tences of various air porosities, grass production leeward of snow fencing, snow reten-tion by vegetative barriers of crop stubble and perennial tall wheatgrass, and snow retention by striperopping. Snow deposition by windbreaks was also noted. Snowmelt storage efficiencies in soil generally exceeded 60%. The tall wheatgrass barrier system deposited snow onto crop target areas, significantly enhancing crop yields. This system should be adaptable to a large part of the Great Plains north of the 39 degrees latitude where aver-age annual snowfall exceeds 28 inches. Better snow control for both agricultural and nonagricultural areas, such as highways, is warranted. (Moore-SRC W81-01941

#### BENEFITS OF DRAINAGE AND IRRIGATION A CLAYPAN SOIL,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering

W. D. Goetsch, and P. N. Walker.

Paper No 79-2551 presented at 1979 Winter Meeting, American Society of Agricultural Engineers, December 11-14, 1979, New Orleans, LA, 4 p, 9 Fig. 1 Tab, 3 Ref. American Society of Agricultur-al Engineers, St. Joseph, Michigan. OWRT B-120-

Descriptors: \*Clays, \*Impervious soils, Hardpan, \*Drainage practices, \*Irrigation practices, \*Corn(Field), \*Crop response, Crop production, Expansive soils, Cohesive soils, Drainage systems, Drainage effects, Tiles, Irrigation water, Crop yield, Agriculture, Irrigation effects, Moisture availability, Vegetable crops, Illinois, Growth

This 1977-1979 study sought to determine corn yield, as well as soil moisture, plant stress, and weather-related variables, as functions of drainage practice on both irrigated and non-irrigated claypan soils to facilitate increased understandings of drainage and irrigation and their effects on claypan soils. Twenty 18m x 32m plots, each having one of ten different combinations of irrigation and drain-age treatments, were studied. Irrigated plots average treatments, were studied, irrigated plots averaged 9.1 tonnes/hectare (tph); unirrigated plots, 7.1 tph. Drainage treatments showed that surface drainage plots, surface plus subsurface plots, subsurface drainage plots, and no drainage plots averaged 9.6, 10.6, 11.2, and 1.0 tph, respectively. Any of several methods, used for monitoring sail methods, used for monitoring sail aged 36, 10.6, 11.2, and 17.9, the previety. Any of several methods used for monitoring soil moisture could be used to indicate when irrigation water application is warranted. Greatest differences were noted for 1979 (due to low precipitation for 1977 and 1978). The 1979 data will be used primarily to build models to predict corn yield form irrigation-drainage practices and weather trends. Prediction will allow cost-benefit determination for tile drainage/irrigation on southern Illinois claypan soils. (Zielinski-IPA)

PLANT AND CANOPY TEMPERATURES IN CORN AS INFLUENCED BY DIFFERENTIAL MOISTURE STRESS,

Nebraska Univ., Lincoln. Dept. of Agricultural

B. R. Gardner. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173908, Price codes: A07 in paper copy, A01 in microfiche. Master of Science Thesis, Agricultural Meterology Progress Report 80-1, December, 1979. 119 p. 31 Fig. 10 Tab, 83 Ref. 2 Append. OWRT B-044-

\*Engineering Descriptors: \*Engineering structures, \*Corn(Field), \*Crop response, \*Temperature, \*Moisture stress, \*Canopy, Moisture availability, Air temperature, Soil temperature, Thermal stress, Cover crops, Irrigation practices, Irrigation water, Irrigation effects, Growth rates, Vegetable crops, Crops, Crop yield, Agriculture, Nebraska.

This study evaluated: temperature differences between stressed/non-stressed corn, optimum time-of-day to estimate maximum temperature difference, the effect of moisture stress on leaf and air temperature profiles within corn canopies, temperatures measured with an infrared thermometer versus leaf thermocouples, detectability of plant moisture status differences from minimum leaf temperatures, effectiveness of five crop temperature indices (to estimate phenological growth stage); and used canopy temperatures to estimate grain yield and seasonal water consumption in moisture stressed corn. Height differences between fully irrigated/non-irrigated plants was 50 centimeters. Average difference in mid-day canopy temperature between stressed/non-stressed areas was as large as seven degrees Centigrade. The possibility of using crop temperature measurements to evaluate effec-tiveness for various irrigation scheduling techniques is suggested. It was concluded that 1400 solar time was good for estimating T-max, the maximum temperature difference between stressed and non-stressed plants. The data suggested that crop temperatures can be used to assess the severity of moisture stress. (Zielinski-IPA) W81-01948

STRATEGY FOR IRRIGATION DEVELOP-MENT IN EGYPT UP TO THE YEAR 2000, Ministry of Irrigation and Sudan Affairs, Cairo

(Egypt). E. M. A. Samaha, and M. Abu-Zeid. Water Supply and Management, Vol 4, No 3, p 139-146, 1980.

Descriptors: Irrigation systems, \*Reviews, \*Nile River, Water rights, Flood plains, Deltas, Dams, 'Irrigation practices, Future planning, Impound-ments, Water demand, Crop production, Water resources development, Automation, Costs, \*Pro-jections, Irrigation efficiency, \*Egypt.

A review of irrigation systems in Egypt from ancient times to the projected systems of the year 2000 is presented. The ancient civilizations depended upon the yearly flooding of the Nile basin to practice agriculture. To facilitate irrigation the Shadouf was employed to lift water to higher areas. This was later replaced by the water wheel, areas. This was later replaced by the water wheel, which was then mechanized by diesel or electric pumps. In the last ten years, irrigation has been rapidly expanded to meet the increasing populations of developing countries. In Egypt, the rate of development depends on technical and economic factors which are closely linked with the social habits and traditions of the nation. In view of this fact, it has been suggested that the development of irrigation in this country will proceed in three stages. The first stage involves improvement of stages. The first stage involves improvement of control and distribution of irrigation water, which will take about five years to implement. Stage two concentrates on the development of field irrigation systems, which has been complicated by the number of small farms rather than larger geographical areas. The third stage will deal with the economics of irrigation development, with plans to charge each farmer for the amount of water actually used. It was projected that the second and third stages would be completed by the year 2000. It was proposed that an authority be set up to super-

vise affairs in field irrigation development. Recommendations were also made for national projects to take priority over field level improvements, as the latter would require more time and effort to implement. (Geiger-FRC)
W81-01950

CASE STUDY ON WATERLOGGING AND SA-LINITY PROBLEMS IN PAKISTAN,

National Engineering Services, Lahore (Pakistan). S. M. H. Bokhari. Water Supply and Management, Vol 4, No 3, p 171-192, 1980. 4 Tab, 12 Ref.

Descriptors: \*Irrigation systems, \*Pakistan, \*Indus river, Water quality, Water resouces, Drainage wells, Water management, River basins, Land reclamation, Future planning, Saturated soils, \*Irrigation practices, Salinity, Groundwater, Percolation, Social aspects, Waterlogging.

The gravity flow irrigation network of Pakistan is The gravity flow irrigation network of rakistan is probably the largest on earth. It handles over 100 million acre-feet of water per year to supply an area of approximately 33 million acres. The Pakistan irrigation system is made up of 2 large dams, 20 small dams, 20 barrages and diversion weirs, over 90,000 farm outlets and 40,000 miles of irrigaover 90,000 farm outlets and 40,000 miles of irriga-tion channels. Many flood protection dikes and embankments and a network of surface drainage are featured in the gravity system. The system suffers from low economic output per unit of water diverted at the source due to a wide gap between supply and demand of irrigation water, excessive water losses in the system, inefficient irrigation, insufficient drainage, outmoded land and water management techniques, waterlooging and water management techniques, waterlogging and salinity, and greatly fragmented land holdings. To remedy the problems of salinity and waterlogging many projects have been undertaken, among them the Salinity Control and Reclamation Program. Socioeconomic factors add to the complexity of the problem in the face of increasing population, food deficits and the use of most of the water resources for primitive irrigation techniques. Several reclamation and groundwater projects have been undertaken, and the advice of foreign agencies has been examined to remedy the situation. Future courses of action that are planned for the Indus Basin are also discussed. (Geiger-FRC) W81-01953

#### 4. WATER QUANTITY MANAGEMENT AND CONTROL

#### 4A. Control Of Water On The Surface

DETENTION LAKE APPLICATION MASTER DRAINAGE PLANNING,

Proctor and Redfern Ltd., Toronto (Ontario). A. T. K. Fok, and S. H. Tan.

A. T. K. Fok, and S. H. Tan.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-173858,
Price codes: Al I in paper copy, A01 in microfiche.
In: Proceedings, Stormwater Management Model
(SWMM) Users Group Meeting, 19-20 June, 1980, Toronto, Ontario, Environmental Protection Agency Report EPA 600/9-80-064, December, 1980, p 178-199. 9 Fig, 4 Tab, 2 Ref.

Descriptors: \*Urban drainage, \*Model studies, \*Urban runoff, \*Storm water, Storm runoff, Canada, Urbanization, Drainage systems, Cost analysis, Rainfall, Lakes, \*Controlled drainage.

A stormwater drainage analysis carried out for the A stormwater drainage analysis carried out for the Edmonton Development area in Canada recom-mended the conversion of existing sloughs and depressions into a system of aesthetic urban lakes interconnected for controlled drainage. Computer models are used for simulating the various hydro-logic conditions and testing the hydraulic re-sponses within the system. The results of modelling are further used to optimize the number, size and layout of the proposed lake system with respect to

#### Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

#### Group 4A-Control Of Water On The Surface

economics, design, hydraulic operation and development constraints. The best drainage alternative is the controlled release to the Kennedale Storm Sewer System with storage ponds. Based on rainfall data, the proposed 10.3 cm-day lake storage system is adequate for the whole 1700 ha Lake District. The optimum lake system is found to consist of three lakes in a balanced design, in which lake area and outflow rates are based on the respective tributary areas. Kidney shaped lakes are proposed with side slopes of 7:1 and surface areas of 1.6 and 2.0 ha at permanent water levels. During hydraulic simulation, no instability was found (Moore-SRC) W81-01930

ALTERNATIVE URBAN FLOOD RELIEF MEASURES; A CASE STUDY; CITY OF REGINA, SASKATCHEWAN, CANADA, Theil (Paul) Associates Ltd., Brampton (Ontario).

A. M. Candaras.

Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173858, Price codes: A11 in paper copy, A01 in microfiche. In: Proceedings, Stormwater Management Model (SWMM) Users Group Meeting, 19-20 June, 1980, Toronto, Ontario, Environmental Protection Agency EPA 600/9-80-064, December, 1980, p 200-211. 1 Fig, 2 Tab.

Descriptors: \*Urban drainage, \*Storm runoff, \*Model studies, \*Drainage systems, Canada, Cost analysis, Floods, Urban runoff, Sewers, \*Controlled drainage, \*Regina(Saskatchewan).

The City of Regina, Canada, has been plagued by frequent flooding of basements and subways within the Seventh Avenue drainage area. The Hydro-graph Volume Method was used for an analysis of the existing sewer system. The system was found the existing sewer system. The system was found to be heavily overloaded for storms of a 2-year return frequency. Considerable storm water overflows occurred to the sanitary trunk at common manholes. Roof water contributions were quickly overloading the existing sanitary sewer along local streets. A restriction in the storm water flow occurs at the outlet to the Wascana Creek, both by the limited capacity of the sewer and turbulence at the junction chamber. Alternative upgrading schemes were compared. Conventional solutions, regarding the replacement and addition of sewers, were the most costly and would result in greatest inconvenience and disturbance during the construction phase. Alternatives incorporating storage proved to be the most cost-effective. The total storage alternative requires no major upgrading to the existing sewer network. Downspout disconnec-tion is by far the most cost-effective solution for the upgrading of the existing sanitary sewer. The recommended solution calls for the elimination of all common manholes and other interconnections, with storm outlet improvements to the Wascana Creek (Mores SPC). Creek. (Mo W81-01931 . (Moore-SRC)

ANALYSIS OF A CHANCE-CONSTRAINED RESERVOIR CONTROL MODEL. IBM Watson Research Center, Yorktown Heights,

M. Sniedovich. Water Resources Research, Vol 16, No 5, p 849-853, October, 1980. 13 Ref.

Descriptors: \*Model studies, \*Eisel's equation, \*Reservoir design, Design, Mathematical models, Flow, Planning, Storage capacity, Reservoir storage, Reservoir releases, \*Reservoir operation.

Eisel's infinite reservoir model for estimating the distribution function of reservoir storage levels under a general linear release rule is shown to overestimate the tails of the distribution function, possibly leading to unduly conservative design and operation policies. This model does not perform well in the case of a finite reservoir. Its main well in the case of a finite reservoir. Its main problem is the positive errors introduced by the use of theoretical storage levels, ignoring shortage and overflow, and allowing storage levels to take values outside the constraints of the reservoir capacity. Several numerical examples are presented to support these observations. (Cassar-FRC) W81-01959

RIVER MANAGEMENT IN THE URBAN EN-VIRONMENT.

For primary bibliographic entry see Field 4C. W81-02050

MATHEMATICAL MODEL FOR IMPROVING COMBINED SEWER SYSTEMS, Public Works Research Inst., Ibaraki (Japan).

E. Nakamura Journal of the Water Pollution Control Federation, Vol 52, No 5, p 899-905, May, 1980. 11 Fig, 2 Tab,

Descriptors: \*Combined sewers, \*Computer models, \*Overflow, Runoff, Water pollution sources, Biochemical oxygen demand, Suspended solids. Chemical oxygen demand, Water storage, Japan, Hydrograph analysis, \*Tokyo, Model stud-

A deterministic computer model of a combined A deterministic computer model of a combined swere system was developed. Three pollutants were considered: 5-day 20C biochemical oxygen demand, suspended solids, and manganate chemical oxygen demand. A simulation run applied the model to a typical Tokyo community with an area of 542 ha. Hydrographs were generated using the Rippl method, and corresponding pollutographs were derived using equations in the model. Tenyear rainfall data were used. Using the model, temporary storage of the excess overflows was found to be the most effective method of reducing total discharged loads for the combined sewer total discharged loads for the combined sewer system. Porous pavement was also effective for pollution control. The model program has an over-flow subroutine and a treatment plant subroutine; thus the effect of any additional treatment at over-flow points or at the treatment plant can be simu-lated. (Small-FRC)

DETENTION STORAGE FOR URBAN FLOOD

Espey Huston and Associates, Inc., Dallas, TX. For primary bibliographic entry see Field 2E

#### 4B. Groundwater Management

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN SHERMAN COUNTY, TEXAS, PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUM-PAGE RATES, PUMPING LIFTS, AND WELL VIETUS. YIELDS.

Texas Dept. of Water Resources, Austin.

A. E. Bell, and S. Morrison. Report 253, September, 1980. 64 p, 18 Tab, 75 Ref, 24 Maps.

Descriptors: \*Texas, \*Aquifers, \*Groundwater potential, \*Recharge, Water supply, \*Water table, Irrigation, Storage depletion, Rainfall, Precipitation intensity, Hydraulits, Water wells, Data collections, Computer programs, Digital computers, Storage coefficient, Projections, \*Ogallala aquifer(TX), \*Sherman County(TX).

To provide information concerning the water shortage problems in the High Plains of Texas, high-speed computers were used to conduct evaluation and projection studies of groundwater re-sources. Historical pumpage has been approximate-ly eleven times the rate of natural recharge. Sher-man County's total annual agricultural income of \$65 million is dependent on fresh groundwater supplied by the Ogallala aquifer. Severe overdrafts threaten to deplete the aquifer to the point that it may not be economically feasible to produce water for irrigation. Water-use patterns between 1960 and 1972 were used to develop an aquifer depletion schedule. To estimate the volume of water in storage in the aquifer, an electronic digital computer constructed maps reflecting the saturated thickness of the aquifer. A computer program also calculated future saturated thickness at individual well sites.

Estimates of current pumpage were obtained as were estimates of the Ogallala's well-yield. The report uses maps, charts, and tabulations to make reasonable projections about the future conditions of the Ogallala aquifer. (Garrison-Omniplan)

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN MOORE COUNTY, TEXAS, PRO-JECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUM-PAGE RATES, PUMPING LIFTS, AND WELL

Texas Dept. of Water Resources, Austin. A. E. Bell, and S. Morrison.

Report 252, August, 1980. 64 p. 18 Tab, 77 Ref, 24

Descriptors: \*Texas, \*Aquifers, \*Groundwater potential, \*Water supply, \*Recharge, \*Water table, Irrigation, Computer programs, Storage coefficient, Precipitation intensity, Hydraulics, Water wells, Data collections, Rainfall, Storage depletion, \*Ogaliala aquifer(TX), \*Moore County(TX).

This is one in a series of planned and executed county studies to alert water users and government officials to the declining groundwater resources of the Ogallala aquifer in the High Plains of Texas. Historical pumpage has exceeded 200,000 acre-feet annually, which is approximately ten times the rate annually, which is approximately ten times for rate of natural recharge to the aquifer in the county. Groundwater is extremely important to the county's economy, as most of the crops are irrigated with groundwater. The report contains maps, charts and tabulations which reflect estimates of the volume of water in storage in the aquifer in Moore County and the projected depletion of this supply by decade periods through the year 2020. observations were made from existing water level wells by examining water-use patterns between 1960 and 1972. An electronic digital computer was 1960 and 1972. An electronic digital computer was used to construct maps which reflect the saturated thickness of the aquifer for those years, and a computer program was written to calculate future saturated thickness at individual well sites. Another purpose was to predict future overdraft consequences. However, a variety of economic and meteorological uncertainties limit these predictions meteorological uncertainties limit these predictions to a reasonable set of general expectations. Conservation practices would additionally affect these projections. It is hoped that this study will help persuade water users to implement all possible conservation measures. (Garrison-Omniplan) W81-02001

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN ARMSTRONG COUNTY, TEXAS, PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUM-PAGE RATES, PUMPING LIFTS, AND WELL VIET DE VIELDS.

Texas Dept. of Water Resources, Austin.

A. E. Bell, and S. Morrison. Report 251, August, 1980. 64 p, 18 Tab, 76 Ref, 24

Descriptors: \*Texas, \*Aquifers, \*Groundwater potential, \*Recharge, \*Water table, Rainfall, Precipitation intensity, Irrigation, Storage coefficient, Hydraulics, Water wells, Data collections, Computer programs, Digital computers, Water supply, \*Ogallala aquifer, \*Armstrong County(TX).

The principal source of fresh groundwater in Armstrong County is the Ogallala aquifer; however, the withdrawl of groundwater during the past three decades has been approximately two and one-half times the rate of natural recharge. If this content of the particle with the decades of the particle with one-half times the rate of natural recharge. If this overdraft continues, the aquifer will be depleted to the point that it may not be economically feasible to produce water to irrigate Armstrong County's crops, which yield a total annual farm income exceeding \$14 million. This study was conducted to find ways to inform water users, via maps, charts and tabulation, of the groundwater depletion, and to provide information to local, state and federal officials to we in implemention. federal officials to use in implementing plans to alleviate the water shortage problem in the High Plains of Texas. Records from existing water level

#### WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

#### Groundwater Management—Group 4B

observation wells provided the study's principal data base, which included: (1) measurements of the depth to water below land surface; (2) the dates these measurements were made; and (3) the depth from land surface to the base of the Ogallala aquifer. High-speed computers were used for automatic data processing. Uncertainties exist about future overdrafts related to various price and depend for the control of the control o demand factors. (Garrison-Omniplan) W81-02002

OCCURRENCE AND QUALITY OF GROUND-WATER IN THE EDWARDS-TRINITY (PLA-TEAU) AQUIFER IN THE TRANS-PECOS REGION OF TEXAS,

Texas Dept. of Water Resources, Austin. R. Rees, and A. W. Buckner. Report 255, September, 1980. 41 p, 9 Fig, 3 Tab, 61 Ref.

Descriptors: \*Texas, \*Aquifers, Groundwater availability, Water supply, Water table, \*Recharge, \*Irrigation, Discharge measurement, Water wells, Hydraulics, Storage depletion, \*Water quality, Data collections, Computer programs, \*Trans-Pecos Region(TX).

With the development of large-scale irrigation, dis-charge from the Edwards-Trinity aquifer has exceeded recharge in most of the irrigation areas and water has been withdrawn from storage. This study surveys information since 1973, including available geologic and hydrologic data, subsurface data, water levels in wells and chemical composi-tion of water in wells to assess groundwater use and quality. Long-term water level declines were found to be most pronounced in the central Reeves County irrigation area, in the north and south Coyanosa, and in the Fort Stockton-Leon-Belding irrigation areas of Pecos County. This decline in water levels has caused Comanche Springs and water levels has caused Comanche Springs and Leon Springs to stop flowing. In those parts of the aquifer that have not been developed for irrigation, such as in Terrell and southern Pecos Counties, the recharge and discharge have remained almost in equilibrium and the aquifer contributes flow to the Rio Grande and the Pecos River through seeps and springs. The quality of water within the aquifer was found to vary from less than 500 to more than 5,000 milligrams per liter of dissolved solids. It is recommended that monitoring programs be updated regularly to ensure long-term water quality and supply. (Garrison-Omniplan) W81-02003

RECORDS OF WELLS, WATER LEVELS, PUM-PAGE, AND CHEMICAL ANALYSES OF WATER FROM THE CARRIZO AQUIFER IN THE WINTER GARDEN AREA, TEXAS, 1970 THROUGH 1977.

Texas Dept. of Water Resources, Austin. G. R. Elder, G. L. Duffin, and E. Rodriguez, Jr. Report 254, September, 1980. 125 p, 4 Tab, 6 Ref, 6 Maps.

Descriptors: \*Texas, \*Aquifers, Water wells, water table, \*Water levels, Water supply \*Chemical analysis. Irrigation, Groundwater, \*Water quality, Storage depletion, Utilities, Hydraulics, Data collections. Computer programs, Digital computers, \*Carrizo aquifer(TX), Winter Garden area(TX).

Groundwater pumpage, water levels and chemical quality of groundwater in the Carrizo aquifer were examined by studying wells in seventeen counties in this area. The objectives of the study were to update records in groundwater pumpage and water level monitoring programs for refinement of the digital computer model and to continue monitoring. digital computer model and to continue monitoring water quality. Most of the water pumped from the Carrizo aquifer is used for irrigation. In 1970 the largest quantity used for irrigation was in Zavala County, while in 1971-1975 it was in Frio County. Water levels declined about 320 feet in Zavala County from 1929-1930 to 1976, while for the same period, water levels rose in Dimmit County in most of its central and eastern parts. There have been no significant changes in groundwater quality except on a local basis, such as leaks in the casing, which were remedied. In addition to mailed questionnaire responses, irrigation pumpage was determined by: (1) obtaining data from utilities regard-ing cubic feet of natural gas and kilowatt-hours of eletricity supplied to irrigatd farms; (2) conducting power and yield tests on selected irrigation wells; and (3) multiplying the average number of gallons produced per cubic foot and kilowatt-hours by total amount supplied by the utilities. (Garrison-Charistee) Omninlan) W81-02004

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN RANDALL COUNTY, TEXAS, PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUM-PAGE RATES, PUMPING LIFTS, AND WELL

Texas Dept. of Water Resources, Austin.
A. E. Bell, and S. Morrison.
Report 250, July 1980. 64 p, 18 Tab, 24 Maps.

Descriptors: \*Texas, \*Aquifers, \*Groundwater-re-charge, \*Water table, Irrigation, Storage coeffi-cient, Rainfall, Precipitation intensity, Hydraulics, Water wells, Data collections, Computer pro-grams, Digital computers, Storage depletion, Po-rosity, Pumping, Drawdown, Water levels, \*Ogal-lala aquifer(TX), \*Randall County(TX).

One of a series of studies covering the declining groundwater resources of this aquifer in the High Plains of Texas. It is hoped this report will help local, State and Federal officials implement plans to alleviate the water shortage in this area. Historiate the state of the st cal pumpage in Randall County, which has numer-ous agribusinesses, has been about four times the ous agnousinesses, nas been about four times the rate of natural recharge to the aquifer. The principal source of fresh groundwater is the Ogallala aquifer. In Randall County, the Ogallala receives natural recharge from local precipitation and from adjoining areas; however, obtaining a reliable recharge rate is complicated by many factors. The Texas Department of Natural Resources maintains water level observation wells which provided the Texas Department of Natural Resources maintains water level observation wells which provided the principal data base used in this study. Water-use patterns between 1960 and 1972 were used to develop an aquifer depletion schedule. Using these data, a computer program was written to calculate future saturated thickness at individual well sites. To estimate the volume of water in storage in the aquifer, an electronic digital computer was used to construct maps which reflect the saturated thickness of the aquifer. Estimates of current pumpage were also obtained. In calculating pumping lifts, procedures similar to those used to estimate volume of water in storage and pumpage were employed, also using the computer and the original data base. Estimates of the Ogallala's well-yield are presented, but are subject to localized geological conditions. Using maps, charts and tabulations, this report makes reasonable projections but not absolute predictions about the depletion of the Ogallala aquifer. (Atkins-Omniplan)

ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN SWISHER COUNTY, TEXAS, PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUM-PAGE RATES, PUMPING LIFTS, AND WELL VIELDS.

Texas Dept. of Water Resources, Austin. A. E. Bell, and S. Morrison.

Report 249, July 1980. 64 p, 18 Tab, 24 Maps.

Descriptors: \*Texas, \*Aquifers, \*Groundwater-re-charge, \*Water table, Irrigation, Storage coeffi-cient, Rainfall, Precipitation intensity, Hydraulics, Water wells, Data collections, Computer pro-grams, Digital computers, Storage depletion, Drawdown, Water Levels, \*Ogallala aquifer(TX), \*Swisher County(TX).

During the past three decades, the withdrawal of groundwater has greatly exceeded the natural recharge to this aquifer. If this continues, there will be reduced well yields and it may not be economior reduced went yields and it may not be economically feasible to produce water for irrigation. Swisher County is a leading producer of agricultural crops in the State, most of which are irrigated with groundwater. Because the Southern High Plains area is hydraulically independent of adjacent areas and has little local rainfall, water withdrawn from the aquifer is not quickly replaced by natural recharge. Changes in soil and land surface accompanying large-scale irrigation may have positively affected the recharge from precipitation however, reliable estimates are difficult to obtain because of factors such as irrigation recirculation. Water-use patterns between 1960 and 1972, deter-mined by water level wells, were used to develop mined by water level wells, were used to develop an aquifer depletion schedule. A computer was used to construct maps reflecting the saturated thickness of the aquifer for these same years, as well as to estimate volume of water in storage and to determine pumping lift. Estimates of future well-yield are projected, but these projections will be influenced by many factors. This study uses maps, charts and tabulations in an effort to persurde water users to implement all possible conservations. suade water users to implement all possible conservation measures so that the remaining groundwater is used most prudently. (Atkins-Omniplan)

LAND-SURFACE SUBSIDENCE IN TEXAS COASTAL REGION,

Geological Survey, Austin, TX. Water Resources

For primary bibliographic entry see Field 2F. W81-02031

WATER-SUPPLY ASSESSMENT OF THE LAR-AMIE-FOX HILLS AQUIFER IN PARTS OF ADAMS, BOULDER, JEFFERSON, AND WELD COUNTIES, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.

P. A. Schneider, Jr. P. A. Schneider, Jr. Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$13.50 in paper copy, \$6.50 in microfiche. Geological Survey Open-File Report 80-327 (WRI), 1980. 17 p. 2 Fig. 6 Plates, 2 Tab, 12 Ref.

Descriptors: \*Water supply, \*Groundwater, \*Water quality, \*Available water, \*Colorado, Po-tential water supply, Aquifers, Water resources development, Water utilization, Confined water, Recharge, Groundwater movement, Water wells, Potentiometric level, Water levels, Pumping, Drawdown, Aquifer characteristics, Water storage, Chemical analysis, \*1 aquifer, Coal Creek Basin(CO). \*Laramie-Fox Hills

Groundwater in the Laramie-Fox Hills aquifer is a Groundwater in the Laramie-Fox Hills aquifer is a potential source of supplemental municipal water supplies for the communities of Erie, Lafayette, Louisville, and Superior in Colorado. The present water supplies for these communities are not always adequate to meet current demands. The U.S. Geological Survey made a water-supply assessment of the Laramie-Fox Hills aquifer for the U.S. Bureau of Reclamation, which is investigating and available of the superior covers of water for the start of the superior covers of water for the start of the superior covers of water for the superior covers of water for the start of the superior covers of water for the superior covers of the superior covers of water for the superior covers of the sup U.S. Bureau of Reclamation, which is investigating and evaluating alternative sources of water for the communities. Recharge to the aquifer is mostly in the western and southwestern parts of the study area. Groundwater movement is generally from the southwest to northeast. Groundwater discharge in the study area is primarily by pumping wells. Since 1961, this pumping has caused water-level declines of about 250 to 300 feet from Broomfeld to serve of Frie Colorado, Generally, water field to east of Erie, Colorado. Generally, water levels in other parts of the area have remained the same. The aggregate sand thickness determined from well logs ranges from 42 to 360 feet and the mean thickness is 229 feet. The volume of groundmean thickness is 229 feet. The volume of ground-water in storage in the study area is about 5 million acre-feet. Reported yields from 93 wells ranged from 1 to 90 gallons per minute and averaged 22 gallons per minute. Well yields tended to be larger in the areas where aggregate sand thickness is the greatest. The water generally changes from a sodium calcium bicarbonate type to a sodium cal-cium sulfate type as it moves through the aquifer away from the recharge areas. The maximum limit established by the U.S. Environmental Protection Agency for nitrite plus nitrate in public-water sup-plies was exceeded in water from three wells, the plies was exceeded in water from three wells, the maximum limit for fluoride was exceeded in water from two wells, and the maximum limit for seleni-um was exceeded in water from three wells.

#### Field 4-WATER QUANTITY MANAGEMENT AND CONTROL

#### Group 4B-Groundwater Management

W81-02033

COMPARISON OF SPRINKLER UNIFORM-

TTY MODELS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. L. Elliott, J. D. Nelson, J. C. Loftis, and W. E.

Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil En-gineers, Vol 106, No IR4, p 321-330, December, 1980. 2 Fig. 16 Ref.

Descriptors: Statistical methods, \*Statistical models, \*Sprinkler irrigation, Wetting, \*Irrigation systems, Uniformity coefficient, Goodness-of-fit, Model studies.

This study adapted the beta distribution for the Ins study adapted the beta distribution for fine characterization of water application depths of sprinkler irrigation systems, and evaluated the goodness of fit of the linear, normal, and beta models to water application depths. Also, recommendations were developed for selecting the appropriate statistical distribution to be used in a propriate statistical distribution to be used in a specific situation. Linear, normal, and beta statistical models were fitted to 2450 overlapped sprinkler irrigation patterns. The deviations of the three models from the observed water distribution were compared. The beta distribution provided the best fit, but is the least practical to use. The normal model generally fit observed sprinkler distributions better than the linear model at uniformity coeffi-cients above about 0.65. At lower uniformities, the opposite was true. If tables or equations were developed for the ready determination of irrigation performance parameters from the beta distribution, this greater accuracy could encourage its use. At present the normal model is recommended. (Small-FRC) W81-02081

MODELING SUPPLEMENTAL IRRIGATION WATER DEMAND,

Tetra Tech Inc., Lafayette, CA

J. D. Dean.
Journal of the Irrigation and Drainage Division,
Proceedings of the American Society of Civil Engineers, Vol 106, No IR4, p 285-297, December,
1980.

Descriptors: \*Mathematical models, \*Irrigation water, \*Water demand, \*Supplemental irrigation, Meteorological data, Crops, Soil physical proper-

A deterministic hydrology model, ARM-II, was A deterministic hydrology model, ARM-II, was modified to simulate the application to supplemen-tal irrigation water demand. The model was modi-fied to simulate a three-layer soil instead of a twolayer soil, because the additional layer adds the flexibility of more closely defining crop rooting depths and conceptually defines water require-ments more accurately. Also, an irrigation submodel was added. Stochastic climatological models can be used alone if meteorological data covering sufficient lengths of time is available. Irrigation sufficient lengths of time is available. Irrigation water demands for a corn crop grown on Cecil sandy loam soil at Watkinsville, Georgia, were simulated for two 50-year management practices. The two practices were: irrigating when soil matrix potential rose above 0.06 bar, and irrigating when soil matrix potential rose above 1.5 he. The when soil matrix potential rose above 15 bar. The first practice required substantially more water than the second. The model can be used to investigate irrigation water demand under different climate, crop, and soil conditions. (Small-FRC)

#### 4C. Effects On Water Of Man's Non-Water Activities

RIVER MANAGEMENT IN THE URBAN EN-VIRONMENT, R. D. Beaumont.

Municipal Engineer (Johannesburg), Vol 10, No 4, p 43-45, July/August, 1979.

Descriptors: \*Urbanization, \*River systems, \*Urban runoff, \*Flood plains, River flow, Flood control, Legislation, Building codes, Erosion rates, Scour, Channels, Stream erosion, Infiltration, Storm runoff, \*Water managem

Growing urbanization threatens the natural stability of a river system by increasing the proportion of storm run-off and by increasing the intensity of flood discharge. As roads and buildings replace soil and vegetation, a relatively constant degree of permeability is reached causing increased runoff from even typical storms. This runoff requires a from even typical storms. This runoff requires a larger channel for its conveyance, leading to accelerated erosion of river beds and banks. Urbanization can also reduce dry weather flows and reduce groundwater amounts. This can adversely affect the stabilizing vegetation along a river. With erosion and weakened roots, small trees can be uprotted during heavy flows and carried downstream until they catch and restrict flows, causing even more damage from floxding. Urbanization has also resulted in extensive building on floodplains. Recent legislation has acknowledged the problems of rivers and urbanization but has done problems of rivers and urbanization but has done little to help. New attitudes and values are beginning to take hold and this should result in progress toward making urbanization less damaging to river systems. (Seigler-IPA) W81-02050

CHALLENGING COMBINED SEWER PROB-LEMS IN JAPAN,

LEMS IN JAPAN, Ministry of Construction, Ibaraki (Japan). Water Quality Control Dept. M. Kuribayashi, and E. Nakamura. Journal of the Water Pollution Control Federation, Vol 52, No 5, p 890-898, May, 1980. 7 Fig, 3 Tab, 2

Descriptors: \*Combined sewers, \*Urban runoff, \*Overflow, Control, Water pollution sources, Treatment facilities, Performance, Interception, Conveyance structures, Cities, Water quality,

Research carried out by the Japanese Public Works Research Institute to solve combined sewer problems is reviewed, and some examples of conproniems is reviewed, and some examples of con-trol measures taken by municipal governments are presented. Urban runoff management systems have been under study since 1967. Because the popula-tion density of Japanese cities is relatively high when compared with other countries, combined sewer overflow releases more untreated waste water into receiving waters. Also, supernatants from sludge handling facilities are often returned periodically to grit chambers or primary settlers. If supernatants are returned when there is discharge superinants are returned when there is usuching to primary effluent, the quality of the discharged effluent is sometimes poorer than that of plant influent. Possible control methods being studied include swirl concentrator/regulator facilities and stormwater sedimentation basins. Interceptor en-largement, upstream detention, downstream detention, and new trunk sewers are methods being tried by various municipalities. Interceptor enlargement is the most widely applied solution. (Small-FRC) W81-02103

POLITICAL ASPECTS OF URBAN STORM-WATER MANAGEMENT,

Virginia Polytechnic Inst. and State Univ., Blacksburg, Coll. of Engineering. For primary bibliographic entry see Field 2E.

#### 4D. Watershed Protection

SOIL EROSION BY WATER AS RELATED TO MANAGEMENT OF TILLAGE AND SURFACE RESIDUES, TERRACING, AND CONTOURING IN EASTERN OREGON,

Science and Education Administration, Pendleton, OR. Columbia Plateau Conservation Research Center

R. R. Allmaras, S. C. Gupta, J. L. Pikul, Jr., and C. E. Johnson.
Science and Education Administration, Oakland, California, Agricultural Research Results Report ARR-W-10, February, 1980. 57 p, 9 Fig, 25 Tab, 35 Ref, 1 Append.

Descriptors: Cultivation, \*Terracing, \*Contour farming, \*Erosion control, \*Soil management, Oregon, Land forming, \*Soil erosion, Wheat, Legumes, Field crops, Slopes, Runoff, Bioenergy har-

Soil erosion by water was estimated for combina-tions of three management types in the B7, B8, and B9 Major Land Resources Areas of eastern Oregon. The three management types were tillage and residue handling, terracing, and contouring. The Universal Soil Loss Equation was applied along with detailed factor information used in conalong with detailed factor information used in con-servation planning. Wheat-fallow and wheat-pea sequences predominate on the tilled cropland, which constitutes about 43% of the land area. Potential soil erosion in the three Major Land Resource Areas not only differed because of differ-ences in the rainfall and runoff energy factor, but also because of major differences in soil tolerance for soil crosion and percentage of steeper slopes. Slope steepness was the primary factor determin-ing which combination of the three management types was needed. Soil erosion could not be held below tolerance values in the wheat-fallow sequence for slopes exceeding 20%; a combination of all three types was needed for slopes between 12 and 20%; tillage and residue handling along with contour operation sufficed on slopes of less than 12%. On slopes of less than 5%, none of the control measures was needed. The wheat-pea sequence allowed no relaxation of control measures. Erosion control measures affected the amount of residue available for bioenergy harvest; for the test area, as a whole, 50 to 70% of the residue produced is available for harvest; the proportion of harvested area from which residues can be taken ranges from 98 to 62% of harvested area. (Moore-W81-01940

SEDIMENT LOSSES FROM SMALL AGRICUL-TURAL WATERSHEDS IN HAWAII (1972-77), Hawaii Univ., Honolulu. Dept. of Agronomy and

Soil Science. A. El-Swaify, and K. R. Cooley

Science and Education Administration, Oakland, California, Agricultural Reviews and Manuals ARM-W-17, September, 1980. 128 p. 5 Fig. 5 Tab, 26 Ref. Available from U.S. Water Conservation Laboratory, Phoenix, Arizona.

Descriptors: \*Hawaii, \*Soil erosion, \*Agricultural watersheds, "Sugar cane, "Pineapples, Storm runoff, Sediment transport, Tropic regions, Ero-sion control, Roads, Rainfall intensity, Slopes, Small watersheds, Farm management.

In Hawaii, and the humid tropics in general, the magnitudes of soil loss by water crosion are acknowledged to be drastically higher than in temperature regions, but data to confirm this generalization are scarce. Results from studies on the pineapple and four sugarcane fields in Hawaii showed soil losses to be below recommended annual tolerance limits recognized by the Soil Con-servation Service. If these fields are representative, this would indicate that: present farming practices are adequate to control erosion, only very large, rare events are responsible for the majority of the erosion; or sediment sources in Hawaii are rarely agricultural in origin. Analyses of storm characteristics showed that over 90% of the storms recorded at the six different locations were of the Type IA and I distribution as defined by the Soil Conservation Service. These types of storms are characterized by low intensity rainfall and are not conducive to high erosion potential. Both pineapple and sugarcane provided considerable protection only a few months after planting. On watersheds with less than 5% of the area in roads, almost all erosion occurred during, or shortly after, harvest and field preparation. On fields with greater than 5% of the area in roads, erosion occurred during between the control of t almost all significant storm events, and annual erosion rates approached tolerance limits when 20% of the field was in roads. Although erosion was

#### Identification Of Pollutants-Group 5A

observed on the steeper areas, much of the sediment was deposited on lower flat portions of the field before reaching the delivery points at which sediment sampling equipment was installed. (Moore-SRC) W81-01943

## 5. WATER QUALITY MANAGEMENT AND PROTECTION

#### 5A. Identification Of Pollutants

THE QUANTITATIVE AND QUALITATIVE ANALYSIS OF THE WATER SOLUBLE FRACTION OF JET FUELS,

California Univ., Berkeley, Sanitary Engineering Research Lab

Research Lab. S. A. Klein, and D. Jenkins. Water Research, Vol 15, No 1, p 75-82, January, 1981. 6 Fig, 2 Tab, 2 Ref.

Descriptors: \*Separation techniques, \*Fuels, \*Pol-lutant identification, Analytical techniques, Gas chromatography, Water analysis, Chemical wastes, Water pollution, Chemical analysis, Volatility, Organic compounds, Aqueous solutions, \*Jet fuels, Hydrocarbons, Solubility.

Methods for the qualitative and quantitative analysis of water soluble fractions (WSF) of hydrocarbon jet fuels that are common pollutants of aquatic systems are presented. Depending on the volatility systems are presented. Performing of the WSF components, a purge-and-trap or pentane extraction technique may be used for concentration of the pollutants. In quantitative analysis, the recovery need not be 100% as long as high reproducibility can be achieved. In the qualitative detection of the WSF of hydrocarbon jet fuels, full and reproducible recovery of all components is desired. After the WSF components in the raw water samples are concentrated, gas chromatodesired. After the WSF components in the raw water samples are concentrated, gas chromatography is carried out. For WSF of JP-4 fuel, quantitation is best achieved by purge-and-trap concentration, followed by temperature programmed gas chromatography, while for Shale JP-9, pentane extraction must be used. Qualitative analysis of JP-4 and JP-8 is best accomplished by the purge-and-trap method to avoid evaporation of components and making of peaks by the pentane components and masking of peaks by the pentane solvent. Shale JP-8, however, does not give good results when subjected to qualitative analysis by tesuits when subjected to qualitative analysis by the purge-and-trap procedure, due to the small amount of volatile components in this fuel. (Geiger-FRC) W81-01980

DETERMINATION OF HYDROLYTIC ACTIVITIES IN WASTE WATER SYSTEMS BY MI-

CROCALORIMETRY, Innsbruck Univ. (Austria). Hygienisches Inst. For primary bibliographic entry see Field 5D. W81-01984

CONCENTRATIONS OF RADIONUCLIDES IN LAKE ONTARIO WATER FROM MEAS-UREMENTS ON WATER TREATMENT PLANT SLUDGES,

Canada Centre for Inland Waters, Burlington (On-

tario). R. W. Durham, and S. R. Joshi. Water Research, Vol 15, No 1, p 83-86, January, 1981. 2 Fig. 3 Tab, 5 Ref.

Descriptors: \*Fallout, \*Radioisotopes, \*Pollutant identification, Sludge, Water treatment, Lake Ontario, Analytical techniques, Water pollution, Water pollution sources, Lakes, Equations, Spectrophotometry, X-ray fluorescence.

Analyses of aluminum hydroxide sludge for the Analyses of aluminum hydroxide studge for the calculation of radionuclides in the untreated raw water were compared with direct gammaspectral measurements of radionculides in lake water. Sludges from four plants which treated water from Lake Ontario were processed by two different methods. In the first, dried sludge samples were extracted with HCl, and aluminum levels were

determined by atomic absorption spectrometry. In the second method, pelletized dried sludge was analyzed by x-ray fluorescence using a scanning electron microscope beam. Equations were applied to describe relationships between the concentration of radionuclides in raw lake water and the volume of lake water treated per kg of dried sludge. Results showed reasonably good agreement between direct and indirect methods of determining Cs137 and Ra226 in Lake Ontario water. Better agree-ment between results is expected when the rate of alum addition at the water treatment plant is pre-cisely known. All the radionuclides identified at the four plants were traced to fallout from atomic weapons testing, with the exception of the natural-ly-occurring Be7, Ra228, and Th228. The method ny occurring Be7, Ra228, and Th228. The method may not be reliable for the quantification of shorter-lived radionuclides due to the long residence times of the sludges in the settling basins. (Geiger-FRC)

AN AUTOMATED METHOD FOR THE DETERMINATION OF NON-IONIC SURFACTANTS IN WATER,

Water Pollution Research Lab., Stevenage (Eng-

land).
K. W. Petts, and I. Sliney.
Water Research, Vol 15, No 1, p 129-132, January, 1981. 3 Fig. 4 Ref.

Descriptors: \*Surfactants, \*Colorimetry, Automation, \*Pollutant identification, Analytical techniques, Biodegradation, Separation techniques, Water analysis.

An automated technique for the detection of nonionic surfactants in water is described. A modified AutoAnalyzer system was used in the colorimetric analysis, which is based on the reaction of ammoni-um cobaltothiocyanate with the surfactants to produce a colored complex. The complex is extracted into chloroform, and its concentration is measured at 620 nanometers. The detection limit was about 0.5 milligrams/liter, with a standard deviation of 0.2 milligrams/liter at the 10 milligrams/liter level. Approximately 3 samples/hour may be analyzed by the automated system; operation overnight without attendance has proven feasible. The large aqueous-to-solvent ratio (about 25:1) needed to obtain adequate sensitivity of response to the smallor concentrations of non-ionic surfactants presents problems in maintaining the proper flow through the small bore acidflex pump tubes. However, the method may be considered suitable for biodegradability studies of ethoxylate materials and forms the basis for further research in this area. (Geiger-FRC) W81-01987

SPECIES OF DISSOLVED METALS DERIVED FROM OLIGOTROPHIC HARD WATER.

Bayerische Landesamt Munich (Germany, F. R.). C. Steinberg.

Water Research, Vol 14, No 9, p 1239-1250, September, 1980. 9 Fig, 2 Tab, 47 Ref.

Descriptors: \*Metals, \*Chelation, \*Water pollu-tion, Organic matter, Solutes, \*Hardness(Water), Natural streams, \*Pollutant identification, Germany, Lake Walchensee(West Germany).

imples were taken from a small mountain creek, Altlach, which traverses spruce and beech forests on dolomite underground in Upper Bavaria, Lake Walchensee, Germany. Trace metals and al-kaline earth metals were determined by atomic absorption spectrometry. Sodium and potassium were determined by flame spectrometry. Multistage gel chromatography was used to fractionate dissolved organic carbon and associated metals dissolved organic carbon and associated metals including Na, K, Mg. Ca, Al, Fe, Mn, Ni, Cr, Cu, Pb, Cd, and Zn, according to their molecular sizes. All the metals were shown to be present to a measurable degree in chelated form. Of the total concentration of lead found, 97.3% of it was in chelated form. Corresponding figures for Al and Cr were 91.5 and 82.2%, respectively. In each case the metals were chelated with Fe. About 69% of all the metal chelates were represented by Mg

compounds. Specific distribution patterns were identified for Pb and Mn. Pb is preferably chelated by macromolecular substances, Mn by micro ones. Cr seems to behave similarly to Pb. (Baker-FRC)

MOUNT ST. HELENS ASH FALL IN THE BULL RUN WATERSHED, OREGON, MAY-JUNE 1980,

Geological Survey, Portland, OR. Water Resources Div. For primary bibliographic entry see Field 5B.

HYDROLOGY OF THE SELDOVIA AREA,

Geological Survey, Anchorage, AK. Water Resources Div.

For primary bibliographic entry see Field 2F. W81-02037

WATER QUALITY IN RHODE RIVER AT SMITHSONIAN INSTITUTION PIER NEAR ANNAPOLIS, MARYLAND, JANUARY 1976 THROUGH DECEMBER 1978,

Geological Survey, Edgewater, MD. Water Resources Div.

Cory, and P. V. Dresler. R. L. Cory, and F. V. Drester. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220809, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-109, January, 1980. 53 p, 7 Fig. 1 Tab.

Descriptors: \*Water quality, \*Rivers, \*Maryland, \*Estuaries, \*Water properties, Chemical analysis, Water temperature, Salinity, Turbidity, Dissolved oxygen, Hydrogen ion concentration, Water levels, Tidal effects, \*Rhode River estuary(MD).

Water temperature, salinity, turbidity, dissolved oxygen, pH, and water level data were continuously monitored and recorded from the Smithsonian Institution pier near Annapolis, Md., from January 1976 through December 1978. Daily maximum and minimum values are tabulated and summarized, and monthly averages and extremes are presented.
Water temperature ranged from 0.0 to 33.9 Celsius.
Both high and low extreme values exceeded those recorded during the previous 6 years. Salinity pat-terns showed normal seasonal variations and were related to the Susquehanna River inflow, which related to the Susquehanna River inflow, which controls the upper bay salinity. Salinity between 13 and 15 parts per thousand in November and December 1978 were the highest recorded over a 9-year period. Turbidity varied seasonally, with lowest values in winter and highest in spring. Dissolved oxygen ranged from 2,0 to 18.7 milligrams per liter. Large variations between summertime deliv mixing and maxing indicated the high state. daily minima and maxima indicated the high state of eutrophication of the water being monitored. Hydrogen-ion activity (pH) ranged from 7.0 to 10.2 over the 3-year period. The pH changes reflect daily variation in partial pressure of carbon dioxide, which varies inversely with the dissolved oxygen. Water level variation at the monitoring oxygen. Water ever variation at the informal site for the 3-year period was 1.89 meters, with highest water 0.59 meter above mean high water and lowest 0.83 meter below mean low water. An apparent decline of 0.07 meter below previously recorded mean high and mean low water was associated with stronger winds and a prevalance of westerly winds in February during the winter of 1976-1977. (USGS)

W81-02040

A PRELIMINARY ANALYSIS OF BACTERIAL NUMBERS AND BIOMASS IN LANGEBAAN LAGOON.

Cape Town Univ. (South Africa). Dept. of Zoo-

H. G. F. Mazure, and G. M. Branch.

Transactions of the Royal Society of South Africa, Vol 44, No 1, p 43-54, June, 1979. 5 Fig. 2 Tab. 23

Descriptors: \*South Africa, \*Langebaan Lagoon, \*Biomass, \*Bacteria, \*Sediments, Marine microor-

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5A-Identification Of Pollutants

ganisms. Marine bacteria, Suspended solids, Seasonal. Water analysis, Aquatic microbiology, Benthic fauna, Saline water, Mud, Intertidal areas, Organic matter.

The epifluorescent indirect count method was used to analyze the bacterial numbers and biomass of the water and sediments of Langebaan lagoon, a lagoon of marine origin with no riverine input located on the west coast of South Africa. Bacteri-ological samples and particle samples were taken at high tide at seven different sites, while intertidal sediment samples were taken at six sites. During microscopic examination the bacteria were divided into long rods and small coccal forms, and the average size was measured for each category in a sample. Results show a decline in bacterial numbers paralleled by a decline in suspended particles from Saldanha Bay to the head of Langebaan lagoon. This correlation indicates that organic particles provide a limiting substrate for the bacteria. Bacterial biomass and zooplankton biomass are found to be comparable. Bacterial numbers and found to be comparable. Bacterial numbers and biomass in the sediments increased progressively towards the south end of the lagoon accompanied by a decrease in particle size and an increase in percentage mud and percentage organic material. The range of bacterial biomass was from 16 to 232 mg/kg of wet sediment for a mean of approximately 14.2 g/m sq. which was comparable to the biomass of benthic macrofauna. (Seigler-IPA) W81-02055

Vol 52, No 2, p 372-380, February, 1980. 1 Fig, 7 Tab, 13 Ref.

Descriptors: \*Industrial wastes, \*Dairy industry, \*Food processing industry, \*Biological oxygen demand, \*Pollutant identification, Waste water treatment, Waste identification, Milk, Proteins, Carbohydrates, Computers, Organic wastes, Least squares method.

Using least-squares fitting of literature data, an equation to calculate equivalent biochemical oxygen demand (EBOD) was developed for food products. Although this formula is designed primarily for dairy products, it is applicable to other foods as long as the percentages of protein, fat, and carbohydrate are known. The relationship may be expressed as: EBOD = 1.031 (protein) + 0.891 (fat) + 0.691 (carbohydrate). Laboratory-determined BOD values and calculated EBOD values showed good agreement for various milk products.

This tool permits improved waste management in the food industry, relating EBOD to the load found in the plant's effluent and allowing identification of wasteful operations. Use of computer technology makes it possible to apply this approach to multi-product plants. (Cassar-FRC) W81-02088

GAS-CHROMATOGRAPHIC/MASS-SPECTROMETRIC ANALYSIS OF DERIVA-TIZED AMINO ACIDS IN MUNICIPAL WASTE WATER PRODUCTS,

North Texas State Univ., Denton. Dept. of Chem-

.. Burleson, G. R. Peyton, and W. H. Glaze. Environmental Science & Technology, Vol 14, No 11, p 1354-1359, November, 1980, 6 Fig, 4 Tab, 33

Descriptors: \*Amino acids, \*Chlorination, \*Waste water, \*Municipal wastes, Analytical techniques. Chromatography. Nitrogen compounds, Pollutant identification. Chemical reactions.

Twenty common amino acids in municipal waste waters were determined by gas chromatography/ mass spectrometry after cation-ligand exchange and derivatization to N(O)-heptafluorobutyrylisoamyl and N(O)-heptafluorobutyrylisoamyl and N(O)-heptafluorobutyryl-n-propyl esters. Recoveries ranged from 69% for glutamic acid and 80-89% for alanine, tyrosine, tryptophan, ornithine, aspartic acid, and arginine to greater than 90% for glycine, valine, arginule to greater than 20% for gryeine, vanue, threonine, serine, leucine, isoleucine, proline, cys-teine, hydroxyproline, methionine, histidine, phen-ylalanine, and lysine. Several amino acids were chlorinated with hypochlorous acid and some reaction products characterized. Some unusual de-rivatives were chlorotyrosine, dichlorotyrosine, and oxindole derivatives of tryptophan. A com-parison of the method used in this paper and the Beckman 120-C amino acid analyzer showed good agreement. Differences ranged from 1.4 to 48.8% Some disagreements were shown in the determina-tions of cysteine, hydroxyproline, and histidine. Waste water samples, some chlorinated, from 4 cities were analyzed for free amino acids. Superch-lorination of effluents effectively destroyed the amino acids. The presence of chlorotyrosine and dishbest presence of chlorotyrosine and dichlorotyrosine was confirmed. Since the toxicities of chlorinated amino acids have not been re-ported, further work on this subject is needed. (Cassar-FRC)

RELATIONSHIP OF VIRUSES AND INDICA-TOR BACTERIA IN WATER AND WASTE WATER OF ISRAEL, Ministry of Health, Tel-Aviv (Israel). Central Virus Lab.

Virus Lab. Y. Marzouk, S. M. Goyal, and C. P. Gerba. Water Research, Vol 14, No 11, p 1585-1590, November, 1980. 5 Tab, 33 Ref.

Descriptors: \*Viruses, \*Bioindicators, \*Pollutant identification, Water pollution sources, Microorganisms, Indicators, Quality control. \*Israel.

Extensive monitoring of aquatic resources of Israel was undertaken to provide background data on the occurrence of enteroviruses and to determine how adequately bacteriological indicators were reflect-ing their presence. Samples of groundwater (99), potable water (23), sewage and grossly polluted surface water (19), surface water (8), and swimming pool water (6) were examined, making a total of 155 samples. Echovirus type 7 was the predominant virus found, followed by poliovirus I, echovirus 6 and coxsackieviruses B2, B5, and B6. On several occasions, water that had been judged acceptable by current standards was found to contain viruses. Water samples with no detectable fecal or total coliform bacteria counts were shown to contain viruses. No statistical correlation could be detected between the occurrence of bacterial indicators and the presence of viruses in the water. Thus serious doubts were raised about the validity of the use of the indicator bacteria system to predict the virological quality of water. This is particularly true in countries with a high incidence of enteric viral disease. (Baker-FRC) W81-02139

DEVELOPMENT OF THE FACTS PROCE-DURE FOR COMBINED FORMS OF CHLO-RINE AND OZONE IN AQUEOUS SOLU-

American Univ., Washington, DC. Dept. of Chem-

J. Liebermann, Jr., N. M. Roscher, E. P. Meier,

and W. J. Cooper. Environmental Science and Technology, Vol 14, No 11, p 1395-1400, November, 1980. 5 Fig, 2 Tab,

Descriptors: \*Chlorine, \*Ozone, \*FACTS procedure, \*Colorimetry, Water analysis, Analytical techniques, Pollutant identification.

The FACTS procedure (free available chlorine test with syringaldazine) was modified for determination of combined and total available chlorine and, with adaptation, for determination of ozone in and, with adaptation, for determination of ozone in aqueous solution. The color reaction obeyed Beer's Law over the range 0-10 mg per liter (as chlorine). The lower detection limit was 0.2 mg per liter. Color developed within 1 minute and for most samples was stable for 5 minutes. Comparison with the method for total available chlorine by amperometric titration gave a variance between the 2 sets of data of 0.643 mg per liter (as chlorine). The procedure for ozone obeyed Beer's Law from 0 to 4.5 mg per liter ozone and had a lower detection limit of 0.2 mg per liter. (Cassar-FRC) W81-02142

SORPTION CAPACITIES OF GRAPHITIZED CARBON BLACK IN DETERMINATION OF CHLORINATE PESTICIDE TRACES IN WATER,

Rome Univ. (Italy), Ist. di Chimica Analitica. A. Bacaloni, G. Goretti, A. Lagana, B. M. Petronio, and M. Rotatori. Analytical Chemistry, Vol 52, No 13, p 2033-2036, November, 1980. 3 Fig. 4 Tab. 17 Ref.

Descriptors: \*Carbon, \*Adsorption, \*Pesticides, \*Water analysis, Organic compounds, Tenax, Analytical techniques, \*Pollutant identification, Solvents, Chlorinated hydrocarbon pesticides, Polychlorinated biphenyls.

Graphitized carbon black (surface area 100 sq. Graphitized carbon black (surface area 100 sq meters per gram) was tested as an adsorbent for extracting trace organic pollutants from water using known concentrations of 51 organic com-pounds, including organophosphorus and chlorinat-ed pesticides, polychlorinated biphenyls (PCB), al-cohols, polynuclear aromatic hydrocarbons, hycohols, polynuclear aromatic hydrocarbons, hydrocarbons, acids, phenols, ethers, aldehydes, ketones, and esters. Most compounds were 109% adsorbed. Exceptions were 1-hexanol, 1-heptanol, benzyl alcohol, penta-through octadecanes, acetophenone, benzaldehyde, and methyl esters of hexanoic through decanoic acids. Tests with alphabenzene hexachloride using distilled water or drinking water, river water, and sea water showed differences in breakthrough curves depending on trace amounts of substances affecting solubility. Of elution solvents, hexane-diethyl ether (1:1) proved best; the recovery was generally 100% with 50 ml eluant. PCB recovery with this solvent was 30-40%; therefore PCB interference in pesticide determinations was decreased. Comparisons with Tenax 80-100 mesh (2,6-diphenyl-p-phenylene oxide) showed that Tenax had lower retention times for several pesticides. (Cassar-FRC) W81-02149

DETERMINATION OF ARENES, VINYL CHLORIDE, AND OTHER VOLATILE HA-LOORGANIC COMPOUNDS IN WATER AT MICROGRAM-PER-LITER LEVELS BY GAS CHROMATOGRAPHY,

New York State Dept. of Health, Albany. Div. of Labs. and Research.

R. S. Narang, and B. Bush. Analytical Chemistry, Vol 52, No 13, p 2076-2079, November, 1980. 5 Fig, 4 Tab, 7 Ref.

Descriptors: \*Trihalomethanes, \*Organic compounds, \*Pollutant identification, Halogenated organic compounds, Water analysis, Vinyl chloride, Analytical techniques, \*Gas chromatography.

Volatile halogenated organic compounds, such as chloroform, carbon tetrachloride, trihalomethanes, and di-, tri-, tetra- and hexa- halogenated ethylenes and ethanes, were stripped from water in a closed system, transferred to an adsorbent and eluted. This method, based on Grob's system, used Poropak N in place of charcoal as the adsorbent and methanol in place of carbon disulfide as the eluant. Eluted substances were separated by gas chromamethanol in place of carbon disulfide as the cluant. Eluted substances were separated by gas chromatography on a 3-meter Chromosorb 102 column (volatile haloorganics), SE-30 on Gas Chrom Q (arenes), and Poropak T (vinyl chloride). Photoionization detectors were used for arenes and vinyl chloride. This procedure, suitable for semiautomatic determinations, has detection limits of 1 mistogram per liter for all compounds. (Ossested) microgram per liter for all compounds. (Cassar-W81-02150

#### 5B. Sources Of Pollution

SIMPLIFIED STORMWATER QUANTITY

AND QUALITY MODEL,
Akron Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Sources Of Pollution-Group 5B

CHARACTERIZATION, MAGNITUDE AND IMPACT OF URBAN RUNOFF IN THE GRAND RIVER BASIN, Ontario Ministry of the Environment, Ottawa. Water Resources Branch.

S. N. Singer, and S. K. So.

Available from the National Technical Information Available from the National Lecturical Information Service, Springfield, VA 22161 as PB81-173858, Price codes: AII in paper copy, A01 in microfiche. In: Proceedings, Stormwater Management Model (SWMM) Users Group Meeting, 19-20 June, 1980, Agency Report EPA 600/9-80-064, December, 1980, p 80-120. 17 Fig, 6 Tab, 10 Ref.

Descriptors: \*Urban runoff, \*Storm runoff, \*Water pollution, Rivers, Canada, Storm water, Dissolved oxygen, Water quality, Nutrients, Phosphorus, Aquatic plants, Aquatic algae, \*Grand Aquatic plants, River(Ontario).

Urban stormwater runoff has been recognized as a potential contributor of pollution to the Grand River in Ontario, Canada, and investigation of pollution from urban sources is an integral part of the basins water quality assessment program. The characteristics of urban runoff and the magnitude of the associated pollution loads from the cities of Brantford, Cambridge, Guelph, Kitchener and Wabrantord, Cambridge, Guelph, Kitchener and Wa-terloo are similar to those reported for other cities in Ontario. The impact of urban runoff from the five cities on the dissolved oxygen regime in the Grand River is minor. Parts of the Speed River below Guelph and certain reaches on the main Grand between Kitchener and Brantford suffer from profuse algae and plant growth during the summer and early fall period. This results in ex-tremely low dissolved oxygen concentrations during the night due to the respiration process. High dissolved oxygen levels are observed during the day as a result of the photosynthesis process. Improvement of the dissolved oxygen regime would require the control of nutrient input, mainly phosphorus, from point and non-point sources. The nutrient input from urban runoff is small relative to agricultural diffuse sources and sewage treatment plants. Therefore priority for pollution control measures should be given to those two sources. (Moore-SRC)

A LONG-TERM DATA BASE FOR THE INVES-TIGATION OF URBAN RUNOFF POLLUTION, Technische Univ., Munich (Germany, F. R.). W. F. Geiger.

W. F. Geiger.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-173858,
Price codes: A11 in paper copy, A01 in microfiche.
In: Proceedings, Stormwater Management Model
(SWMM) Users Group Meeting, 19-20 June, 1980,
Toronto, Ontario, Environmental Protection
Agency Report EPA 600/9-80-064, December,
1980, p 212-233. 16 Fig, 9 Ref.

Descriptors: \*Urban runoff, \*Water pollution, \*Data collections, \*Monitoring, Storm runoff, Combined sewers, Storm sewers, Rainfall, Surface runoff, Water analysis, Biochemical oxygen demand, Chemical oxygen demand, Suspended solids. Nutrients.

Realistic conclusions concerning receiving water pollution can not be derived from rainfall-runoff measurements or simulations of singular events. This is especially true of intermittent storm runoff and the resulting storm or combined sewer overflows. An instrumentation and monitoring program collecting rainfall, runoff, outfall and overflow data has been operated since 1976 in a sequence of closely spaced intervals in two test catchments: one a combined sewer system of 1340 acres, the other a small separate system of 57 acres. For water quality, total suspended solids, biochemical oxygen demand, chemical oxygen demand, Kjeldahl-nitrogen, total phosphorus and total organic carbon were analyzed. The amount of data collected per year is considerable. In 1977 and 1978 approximately one million pieces of data were collected, and therefore data storage and retrieval had to be completely computerized. The data acquired by a small computer at the monitoring station in the larger sewer system are punched on paper tape and then fed into a data bank. All laboratory data base has not been met. Data gaps of different lengths occurred due to mulfunction-ing of individual recorders, the small processor at the monitoring station, or the sampler. The gaps in the runoff data may be filled with simulation re-sults to provide a complete data base. (Moore-W81-01932

ELEMENT FLOW IN AQUATIC SYSTEMS SURROUNDING COAL-FIRED PLANTS: WIS-CONSIN POWER PLANT IMPACT STUDY, Wisconsin Univ.-Madison, Inst. for Environmental

A. Andren, M. Anderson, N. Loux, and R. Talbot. Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB81-106833, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/3-80-076, July, 1980. 94 p, 28 Fig, 19 Tab, 85 Ref. R803971.

Descriptors: \*Powerplants, \*Fly ash, \*Cooling water, \*Water pollution sources, \*Wisconsin, \*Aquatic environment, Water quality, Coal-fired powerplants, Water chemistry, Nutrients, Hydrogen ion concentration, Waste water treatment, Chlorinated hydrocarbons, Trace elements, Copper, Dissolved oxygen.

Water quality parameters of a 192-ha cooling pond adjacent to the Columbia Generating Station, Poradjacent to the Columbia Generating Station, rori-tage, Wisconsin were investigated, including: major and minor elements, nutrients, pH, alkalin-ity, oxygen, chlororganics, phenols, and polyaro-matic hydrocarbons. Similar parameters were also measured in the nearby fly ash discharge basin and its associated drainage stream. Except for copper concentrations, the overall water quality of the cooling basin is similar to that of many southern Wisconsin eutrophic lakes. Copper concentrations are generally below those levels thought to be toxic to aquatic life. Bottom waters may turn anoxic during late summer, causing nutrients from bottom sediments to be released to the overlying waters. Since nutrient release from bottom sediments to the water column may cause severe bio-logical fouling problems, it is important to maintain oxygenated cooling pond waters at all times. Cooling pond water contained non-detectable levels of chlororganics and polyaromatic hydrocarbons, but bottom sediments contained measurable quantities of chlorinated phenols, phthalate esters, and po-lyaromatic hydrocarbons. Results from laboratory studies on dissolution and precipitation reactions of fly ash during equilibrium conditions can not be directly extrapolated to the ash basin at the Colum-bia Generating Station. Major element chemistry determines the reaction mechanism of fly ash disso-lution by establishing solid-solution metastable equilibria. Elevated concentrations of aluminum, boron, cadmium, and copper are present in the fly ash basin at levels deemed toxic to aquatic life, and pH values are always in the range of 9 to 12. The elemental discharge from the ash basin has a negli-gible effect on the water quality of the Wisconsin River. (Moore-SRC) W81-01934

ESTIMATION OF THE DOWNSTREAM RIVER WATER QUALITY WITH A POLLUTION LAND-USE DATA BANK, Institut National de la Recherche Scientifique, Ri-

For primary bibliographic entry see Field 7B. W81-01951

A COMPARISON OF NUTRIENT SOURCES AND BEHAVIOR IN TWO LOWLAND SUB-CATCHMENTS OF THE RIVER WYE,

University of Wales Inst. of Science and Technol-Onversity of water this. of Science and Technology, Cardiff, J. A. Houston, and M. P. Brooker. Water Resources, Vol 15, No 1, p 49-57, January, 1981. 5 Fig. 5 Tab, 24 Ref.

Descriptors: \*Nutrients, \*Land use, \*Livestock, \*Watersheds, Drainage, Water quality, Flow, Nitrate, Groundwater,

Chemical analysis, River basins, Small watersheds, Path of pollutants, \*Runoff, Dairy farms(Upland), Stock farms(Flood plains), \*Wye River(UK). United Kingdom.

Seasonal fluctuations in nutrient flows were stud-ied in two watersheds with different land uses. One site is in intensive floodplain stock farming and one is in upland dairy farming with a lower livestock density. Water samples were evaluated and river flows were measured at weekly intervals over a one year period. Additional data on sewage effluent contributions, groundwater quality and rainfall were collected. The study revealed good agreement between the two watersheds in the seasonal variations and magnitude of nutrient concentra-tions, including silicon and orthophosphate. Concentrations of nitrate nitrogen were higher in one of the watersheds. This result is attributed to greater contributions of sewage and to differences in the upland geology. It was found that overall, orthophosphate concentrations decreased and silicon and nitrate concentrations increased with increased flow caused by storm events. (Titus-FRC) W81-01974

STUDY OF LITTORAL CURRENTS IN COSTA DEL SOL IN RELATION TO THE PLACE-MENT OF SUBMARINE OUTFALLS ENVI-SIONED IN THE COMPREHENSIVE TREAT-MENT PLAN. (ESTUDIO DE CORRIENTES LI-TORALES EN LA COSTA DEL SOL, EN RELA-CION CON LOS EMPLAZAMIENTOS DE EMISARIOS SUBMARINOS PREVISTOS EN EL PROYECTO DE SANEAMIENTO INTE-

Ministerio de Obras Publicas, Madrid (Spain). Aplicaciones Nucleares. or primary bibliographic entry see Field 6A. W81-01975

GULF POLLUTION-UN'S OTHER WORRY.

Nature, Vol 287, No 5782, p 477, October, 1980.

Descriptors: \*United Nations, \*Oil pollution, \*Kuwait, \*Water pollution, Sewage, Water re-sources, Industrial wastes, Air pollution, Pollut-ants, Water quality, \*Persian Gulf, Iraq, Iran.

The United Nations Environment Programme will assist countries in the Gulf of Kuwait area with planning and research into the sources and effects of pollutants in this fragile water supply. This body of water averages only 35 meters deep, and evapo-rates more water than it receives from river runoff. Little basic information exists on the Gulf's oceanography, ecology, and meteorology. Although these waters are needed for drinking, agriculture, and industry, they are exposed to many pollutants heavy metals, noxious gases, oil, municipal sewage. neavy metats, noxious gases, or, municipa sewage, and airborne dust. The institutions and equipment for pollution control have lagged behind the rapid population and industrial development. Hence, the need for research is great. (Cassar-FRC)

BEHAVIOUR OF NITRILOTRIACETIC ACID DURING GROUNDWATER RECHARGE,

Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands)

J. Hrubec, and W. van Delft. Water Research, Vol 15, No 1, p 121-128, January, 1981. 7 Fig. 2 Tab. 18 Ref.

Descriptors: \*Pilot plants, \*Potable water, \*Artificial recharge, \*Water pollution control, Aquifers,
\*Detergents, Surface waters, Water quality, Public health, Groundwater recharge, Heavy metals, Path of pollutants, Water pollution sources, Percolation, Movement, Netherlands, Rhine River, \*Nitrilotriacetic acid.

Research on trisodium nitrilotriacetate (NTA), a constituent of many detergents, has failed to provide sufficient information on the effects of this phosphate substitute in surface and groundwater sources for drinking water supplies. In the Nether-lands, about 40% of the volume of surface water

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5B-Sources Of Pollution

used as potable water is infiltrated in the North Sea dune area as part of its treatment. Artificial re-charge of Rhine River water has also been pro-posed in the Veluwe area. With these factors in mind, a pilot plant study was undertaken to exam-ine the behavior of NTA during artificial groundwater recharge of Rhine River water. The Amsterdam Water Works pilot plant tests were also designed to obtain data on the possible mobilization of heavy metals from the soil of aquifers as a consequence of the formation of NTA-metal com-plexes. Experimental operations were based on fairly low recharge rates and aquifer groundwater fairly low recharge rates and aquiter groundwater environments that were mainly anaerobic. Results indicated that complete removal of NTA during percolation could be expected for NTA levels of up to 2 mg/l in surface water, even during events of low water temperatures. The mobilization of of low water temperatures. The mobilization of trace elements from the aquifer during the percolation of water containing low levels of NTA was not observed and was considered improbable. (Geiger-FRC)

PARTICULATE AND DISSOLVED TRACE METALS IN LAKE ONTARIO, National Water Research Inst., Burlington (Ontar-

io), J. O. Nriagu, H. K. T. Wong, and R. D. Coker. Water Research, Vol 15, No 1, p 91-96, January, 1981. 5 Tab. 32 Ref.

Descriptors: Heavy metals, \*Trace elements, \*Lake sediments, \*Path of pollutants, Suspended solids, \*Lake Ontario, Eutrophication, Sedimentation, Water pollution, Great Lakes, Movement, Nutrients. Fluctuations, Seasonal, Turnovers,

Samples of Lake Ontario water and sediments were collected in the spring and summer of 1978 to determine the residence times of trace metals in the lake water column. Particulate metal levels in nanograms/liter for Cu, Cd, Ni, Zn, Mn and Fe were found to be 690, 40, 180, 1690, and 2100, respections. tively, in the nearshore waters of this Great Lake These concentrations were considerably greater than the particulate metal levels in the offshore waters which were, in nanograms/liter, 130 for Cu, 8 for Cd, 34 for Ni, 230 for Zn, 110 for Pb, 260 for Mn, and 9000 for Fe. In general, the amount of trace metals bound to suspended solids in the lake water was calculated to be 50-80% for Cu, 10-40% 20-60% for Cd, and greater than 60% for The The Test of th rates of deposition on the lake bottom. It was suggested that the particulate organic matter may suggested that the particular organic matter may play an important role in the transport of metals to Lake Ontario sediments. The effects of algal blooms on pollutant metal deposition into lake sediments are also mentioned. (Geiger-FRC)

MOUNT ST. HELENS ASH FALL IN THE BULL RUN WATERSHED, OREGON, MAY-JUNE 1980, Geological Survey, Portland, OR. Water Resources Div.

M. V. Shulters, and D. G. Clifton. Geological Survey Open-File Report 80-593, July, 1980. 11 p. 5 Fig. 3 Tab. 6 Ref.

Descriptors: \*Volcanoes, \*Environmental effects, \*Water quality, \*Large watersheds, \*Oregon, Water supply. Fallout, Particle-size, Water pollution sources, Path of pollutants, Weather patterns, Water chemistry, \*Mount St. Helens(WA), Bull Run watersheds(OR), \*Volcanic ash, Acid rain.

On May 25-26, May 30-June 2, and June 12-13, 1980, strong, high-altitude winds from the north occurred during periods of volcanic-ash eruption at Mount St. Helens in southwestern Washington. As a result, ash fell in the Bull Run watershed. Oregon, some 50 miles to the south, the principal water-supply source for the Portland area. Samples from precipitation collectors and from stream sites in the Bull Run watershed were collected on several dates during May and June 1980. Analyses were made and are tabulated for pH, conductivity, acidity, sulfate, and nitrate plus nitrite. Field pH values of the precipitation ranged from 4.0 to 5.6 pH units and the stream samples from 6.7 to 7.5 units. Particle-size analyses for ash samples collected in the Bull Run watershed and Portland, Oregon, are also shown. Volcanic events, precipioregon, are also shown. Volcame events, precipitation and high-altitude speeds for northerly winds are given for May 18-June 15, 1980. (USGS)
W81-02036

RESPONSE OF LEAD SOLUBILITY TO DIS-SOLVED CARBONATE IN DRINKING DRINKING

Cincinnati, OH. Drinking Water Research Div.

Journal of the American Water Works Association, Vol 72, No 12, p 695-704, December, 1980. 16 Fig. 4 Tab, 44 Ref.

Descriptors: Corrosion, \*Carbonates, \*Pipes, \*Lead, Solubility, Water pollution sources, \*Potable water, Chemical properties, Pollutants, Metals, Heavy metals, Pipelines, Water distribution sys-

A model for relating the theoretical solubility curves for lead to changes in dissolved inorganic carbonate concentration and pH at 25C is presentcarbonate concentration and pH at 25C is presented. Calculated results agreed well with data obtained from pipe loop solubility experiments at inorganic carbonate concentration values of 25, 100, and 200 mg per liter as CaCO3. This model increases the predicted minimum molar solubility of lead by factors up to 10,000 over those suggestion of the properties of the present of the properties of the propertie 9.5. A minimum concentration of carbonate overcomes the higher solubility of lead hydroxide, but an increase in carbonate promotes formation of more soluble lead carbonate complexes. None of the pipe loop tests reduced lead concentration to below the 0.05 mg per liter maximum contaminant level at carbonate concentrations of 0 to 7,950 mg per liter as CaCO3. (Cassar-FRC) W81-02070

WATERBORNE DISEASE: OCCURRENCE IS ON THE UPSWING, Health Effects Research Lab., Cincinnati, OH.

For primary bibliographic entry see Field 5C. W81-02075

FEASIBILITY OF WATER QUALITY IMPROVEMENT IN THREE ILLINOIS RIVERS, Arizona Univ., Tucson.
For primary bibliographic entry see Field 5G. W81-02083

VOLATILE HALOCARBON PRODUCTION FROM THE CHLORINATION OF MARINE ALGAL BYPRODUCTS INCLUDING D-MAN-NITOL. Environmental Research Lab., Johns Island, SC.

Bears Bluff Field Station.

A. M. Crane, P. Kovacic, and E. D. Kovacic. Environmental Science and Technology, Vol 14, No 11, p 1371-1374, November, 1980. 3 Fig. 2 Tab, 30 Ref.

Descriptors: \*Trihalomethanes, \*Chlorination, \*Marine algae, \*Mannitol, Water quality, Chemical reactions, Chloroform, Organic compounds, Glycerol, Proline, Metabolism, Water pollution sources.

Three known byproducts of marine algae metabolism, D-mannitol, glycerol, and L-proline, were reacted with chlorine at molar concentrations of 0.003-0.009, 0.003-0.003, and 0.009-0.003 and pH 7 to 11.4 to investigate volatile halocarbon produc-tion. L-proline reduced Cl without concurrent production of halocarbons under all conditions. Glycerol and mannitol behaved similarly at pH 7 (4-10 micrograms per liter volatile halocarbons produced), but mannitol produced increased total volatile halocarbons (about 560 micrograms per liter) at the highest pH and highest mannitol concentration. Most of this was chloroform, with lesser amounts (16-61 micrograms per liter) of an unidentified product and traces of a third unidentified product. The mechanism of the D-mannitol reaction is believed to be ketolactone formation, followed by ring opening by chloride and the classical haloform process. (Cassar-FRC)

PREDICTION OF THE CONTAMINATION PRODUCED BY DISPERSION OF EFFLUENTS THROUGH OCEAN OUTFALLS. (PREDICTION DE LOS NIVELES DE CONTAMINA-CION PRODUCIDOS POR VERTIDOS REALI-ZADOS A TRAVES DE EMISARIOS SUBMAR-INOS.).

Ministerio de Obras Publicas, Madrid (Spain). Gabinete de Aplicaciones Nucleares.

A. Ruiz Mateo, and P. Sole Romeo Progress in Water Technology, Vol 12, No 1, p 301-320, 1980. 8 Fig, 18 Ref.

Descriptors: \*Outfall sewers, \*Waste dilution, \*Diffusion, Mathematical models, Oceans, Flow, Regulation, Waste water treatment, \*Spain, Dis-

Effluent dispersion after ocean outfall is examined. Spanish laws regulating such methods of treatment are discussed. Existing methods employed to calare discussed. Existing methods employed to cal-culate shoreline pollution resulting from outfall sewers and initial dilution of pollutants are dis-cussed. A new mathematical model is presented which yields distribution curves for pollutants at various distances from the outfall. It is a twodimensional relative diffusion model which divides the set of all possible flow structures into a useful finite number of subsets. (Small-FRC) W81-02129

CONTRIBUTION OF MARINE ALGAE TO TRIHALOMETHANE PRODUCTION CHLORINATED ESTUARINE WATER,

Environmental Research Lab., Johns Island, SC. Bears Bluff Field Station.

A. M. Crane, S. J. Erickson, and C. E. Hawkins Estuarine and Coastal Marine Science, Vol 11, No 3, p 239-249, September, 1980. 6 Fig, 4 Tab, 22 Ref.

Descriptors: \*Chlorophyll, \*Marine algae, \*Triha-lomethanes, \*Estuarine environment, \*Chlorina-tion, Algae, Halogenated compounds, North Edisto River, \*South Carolina.

Algal metabolic byproducts other than chlorophyll were apparently responsible for trihalomethane formation upon chlorination of estuarine water from the North Edisto River, South Carolina, with sodium hypochlorite. Major trihalomethanes produced by chlorination of filtered estuarine water were bromoform (CHBr3) and chlorodibromomethane (CHBr2Cl). The trihalomethane production proceeded rapidly at first and, in the presence of sufficient chlorine, continued at a reduced rate. The presence of marine algae re-duced or enhanced trihalomethane formation dequeed of enhanced trinaiometriane formation de-pending on species. No correlation was found be-tween chlorophyll a concentration and halogen compound formation. However, water containing byproducts of algal metabolism, but no cells, behaved similarly to water containing cells upon chlorination. (Cassar-FRC) W81-02131

GENERATION OF POLLUTING LOADS WITHIN RIVER BASINS,

National Inst. of Scientific Research, Quebec (On-

Couillard, and D. A. Cluis.

Water Research, Vol 14, No 11, p 1621-1630, November, 1980. 3 Fig. 6 Tab, 21 Ref.

#### Effects Of Pollution—Group 5C

Descriptors: \*Model studies, \*Water pollution sources, \*Land use, Water quality, Water quality control, \*River basins, Path of pollutants, Water management, Urbanization, Nitrogen, Phosphorus, Nutrients, \*Quebec, Hydrologic data, Networks, Saint-François River ba

A water quality model was developed to estimate pollution loads along a hydrologic network based on inputs of various land uses along adjacent areas. Pollution load studies are incorporated to devise a rollution load studies are incorporated to devise a simple production and transport scheme that may be used to estimate the quantity of pollution that may be found at any point along the hydrologic network on a daily, seasonal, or annual basis. The relative amounts of pollution produced by different contributing factors may be assessed, and the impact of various man-made changes such as ur-banization, changes in livestock populations and deforestation on the origin of transported loads downstream from the affected zone may be evaluated. The model has been applied to calculate the maximum phosphorus and nitrogen concentrations along 17 simulation points within the hydrographic network of the Saint-Francois River Basin, Quebec. Results generated from the model may be useful to water resource managers in determining priority target sites for water quality improvement programs. (Geiger-FRC)
W81-02134

FIELD MEASUREMENT OF TRANSVERSE FIELD MEASUREMENT OF TRANSVERSE DIFFUSION IN UNDIRECTIONAL FLOW IN A WIDE, STRAIGHT CHANNEL, Loughborough Univ. of Technology (England). Dept. of Civil Engineering. A. P. Cotton, and J. R. West. Water Research, Vol 14, No 11, p 1597-1604, November, 1980. 8 Fig. 2 Tab, 12 Ref.

Descriptors: \*Model studies, \*Mixing, \*Dye dispersion, Channels, Mathematical models, River flow, Water quality, Estuaries, Rivers, Tracers, Diffusion, Rhodamine, Tracking techniques, Turbulence, Prototype tests, Path of pollutants.

Understanding factors which cause mixing in an open channel flow system is important to the study of pollution transport in rivers and saline intrusion in estuaries. Field studies were conducted to meas-ure transverse diffusion coefficients in the River Rea, Birmingham, by use of a Rhodamine WT dye tracer technique. The present work done on this tracer technique. The present work done on this urban stream also focussed on determining the effect of the river flow and estimating the Lagrangian turbulence characteristics. Good dye recovery ratios and data reproducibility were obtained for a range of nearly steady discharge over straight stretches of the stream. The variation of the transverse diffusion coefficient and the dimensionless parameter (beta) with the river flow displayed a linear trend. The values of the dimensionless coefficient which were found were similar to those for other prototype investigations. (Geiger-FRC) W81-02140

ELEMENTAL PARTITIONING IN AN ABOVE-GROUND OIL SHALE RETORT PILOT

PLANT,
Battelle Pacific Northwest Lab., Richland, WA.

Physical Sciences Dept. J. S. Fruchter, C. L. Wilkerson, J. C. Evans, and

J. S. Fruchter, C. L. Wijkerson, J. C. Evans, and R. W. Sanders. Environmental Science & Technology, Vol 14, No 11, p 1374-1381, November, 1980. 3 Fig, 6 Tab, 13 Ref.

Descriptors: \*Pilot plants, \*Trace elements, \*Oil shales, \*Effluents, Industrial wastes, Metals, Path of pollutants, Distillation, Fuels, Paraho, \*Colora-do, Elements(Chemical), Volatility, Inorganic compounds, Chemical wastes, Sulfur, Mercury.

Raw shale and effluent streams from the Paraho. Colorado, semiworks oil shale retort were analyzed for 47 elements using a variety of instrumental techniques to calculate mass balances for major and trace elements and to obtain information on their physical and chemical forms. The elements formed three groups, based on volatility. Category I includes the nonvolatiles, partitioned less than 0.01%, which may enter the entrained shale fines or exist as dissolved ionic species. Examples are Al, Ba, Ca, Cr, Mn, Na, Rb, Si, Cu, K, Mg, Mo, Pb, Sb, Sr, Th, Ti, U, V, and Zn. Category III elements, partitioned 0.01-5%, are primarily redistributed into the product shale oil and are associated with volatile metallic or organometallic compounds. This includes As, B, Co, Fe, Ni, and Se. Category III elements are partitioned more than 20%, are volatile, and include C, H, N, S, and Hg. These elements are found in the product oil and emitted gases. Sulfur is distributed as follows: retorted shale, 80.9%; product oil, 10.4%; product water, 2.5%; and gas, 12.7%. (Cassar-FRC) W81-02141 0.01%, which may enter the entrained shale fines

FACTORS INFLUENCING THE FORMATION OF HALOFORMS IN THE CHLORINATION OF HUMIC MATERIALS,

Imperial College of Science and Technology,

Imperial College of Science and Technology, London (England). C. J. Peters, R. J. Young, and R. Perry. Environmental Science and Technology, Vol 14, No 11, p 1391-1395, November, 1980. 8 Fig. 2 Tab,

Descriptors: \*Trihalomethanes, \*Chlorination, \*Humic acids, \*Fulvic acids, Chloroform, Water quality, Organic matter, Chemical reactions, Water treatment, Water pollution sources, Path of pollutions ants, \*Thames River, England.

Humic acid and fulvic acid fractions isolated from the River Thames were chlorinated to examine haloform (as chloroform) production under condi-tions encountered in water treatment. Total chloroform was composed of 2 components--residual chloroform, produced from thermal decomposition of chlorinated intermediates, and dissolved chloro-form. In both humic and fulvic fractions, dissolved chloroform production increased with both temperature and pH. Humic acid, which has a higher molecular weight and contains more active sites than fulvic acid, produced 1.64-1.68 times as much dissolved chloroform as did fulvic acid. Conversely, residual chloroform formation from both mately, residual chloroform formation from both materials decreased with increases in pH from 7 to 9. Total chloroform formation reached a maximum between pH 7 and 8. A linear equation relates chloroform formation to chlorine consumption (all units mg per liter): Total chloroform concentration at time t = 0.022 (Initial chlorine concentration Chlorine concentration at time T). Thus, the Chlorine concentration at time T). Thus, the amount of trihalomethanes in drinking waters depends on the quality of the source water, process conditions during chlorination, pH, bromine versus chlorine balance, and storage conditions, which affect evaporative losses and decomposition of ha-logenated intermediates to form additional trihalomethanes. (Cassar-FRC) W81-02143

ORGANIC COMPOUNDS IN AN INDUSTRIAL WASTE WATER. THEIR TRANSPORT INTO SEDIMENTS,

SEDIMEN1S, Midwest Research Inst., Kansas City, MO. V. Lopez-Avila, and R. A. Hites. Environmental Science and Technology, Vol 14, No 11, p 1382-1390, November, 1980. 7 Fig. 8 Tab,

Descriptors: \*Chemical wastes, \*Industrial wastes, \*Organic compounds, Path of pollutants, Water pollution, Pollutants, Analytical techniques, pollution, Pollutants, Analytical techniques, Chemical industry, Pollutant identification, Paw-tuxet River, Narragansett Bay, Water analysis, Providence River, Waste water, \*Sediments, Rhode Island

The environmental behavior of organic chemicals contaminating water and sediments of the Paw-tuxet River and Cove, Providence River, and Nar-ragansett Bay in Rhode Island was studied after prior investigations had identified over 120 differ-ent compounds in the waste water of a small chemical specialties manufacturer located up-stream. Compounds identified included benzotriazole, chlorobenzotriazole, diphenyl ether, trichlor-odiphenyl ether, dibenzoazepine, triazine, phenylbutazone, phenylnaphthylamine, stearyl alcohol and BHT ester. Water levels of the compounds

followed the rules of simple dilution. Analysis of fine sediment cores produced good agreement with production histories of selected compounds. Some vertical mixing of sediment layers was seen. At the further stations contaminant concentrations decreased with both depth in sediment and distance from discharge. The most lipophilic compounds were the most highly associated with the particulate matter and were found at the greatest distance from the plant. An equation was developed to predict the sediment concentration: log (concentrapredict the sediment concentration: log (concentra-tion in waste water/sediment concentration) = b1 + b2 (distance from plant/log P), where log P expresses the octanol/water partition coefficient. (Cassar-FRC) W81-02144

HANDLING HAZARDOUS WASTE-AN UN-SOLVED PROBLEM,
Environmental Defense Fund. Washington, DC.

D. J. Lennett. Environment, Vol 22, No 8, p 6-15, October, 1980.

criptors: \*Waste disposal, \*Water pollution, \*Industrial wastes, \*Hazardous materials, Hazards, Regulation, Legislation, Disposal, Landfills, Waste dumps, Legal aspects, Superfund bills, Resource Conservation and Recovery Act, Compensation, Penalties(Legal), Negligence, Public health, Water quality, Environmental Protection Agency.

This paper cites examples of groundwater contamination from improper disposal of hazardous wastes and discusses proposed and present legislation for hazardous waste handling and cleanup. Two Superfund bills are under serious consideration in Congress. H.R. 7020 creates a \$1.2 billion fund for emergency response activity and remedial activity at top priority sites. No relief is provided for victims of releases from waste sites. The more comprehensive \$1.480 proposes a \$4.085 billion fund for cleaning up any hazardous substance release, compensates victims for damages, and prolease, compensates victims for damages, and pro-vides for health studies and natural resource rehavides for nearth studies and natural resource rena-bilitation. Polluters are held strictly liable for cleanup and damages. Most chemical manufactur-ers oppose both bills, but a few favor H.R.7020. Environmentalists support S.1480. Although the Resource Conservation and Recovery Act (RCRA) became law in Oct. 1976, EPA has repeatedly failed to meet promulgation deadlines, leaving some measures still unfinalized 4 years leaving some measures still unfinalized 4 years after passage of the act. The author points out RCRA inadequacies, in addition to its incompleteness. Many toxic wastes are not yet identified as hazardous and escape regulation. The National Interim Primary Drinking Water Standards (NIPDWS) regulate only 14 substances (8 heavy metals and 6 organics). Sampling and extraction proceedures for waste streams are very inadequate. metals and o organics). Sampling and extraction procedures for waste streams are very inadequate. Exemptions from regulations for small waste generators (less than 2,200 lbs per month), hazardous waste mixed with domestic sewage, and recycled and reused wastes ensure that much toxic material enters the environment. Interim state regulations are not uniform and fines are not punitive. Public opinion polls show that a large majority of Americans want stricter waste control even at the ex-pense of higher cost for consumer products. (Cassar-FRC)

#### 5C. Effects Of Pollution

X-RAY ANALYSIS OF SEDIMENT REGIONS AND TRANSPORT OF SEDIMENT PARTICU-LAR MATERIAL ON THE GILL OF THE FIN-GERNAIL CLAM, MUSCULIUM TRANSVER-

Southern Illinois Univ. at Carbondale. Dept. of Zoology.

A. Paparo, J. A. Murphy, and R. Sparks.
In: 38th Annual Proceedings, Electron Microscopy Society of America, 1980, San Francisco. CA, p 562-563. 3 Fig. OWRT B-119-ILL(4).

Descriptors: \*Sediments, Particle size, Sampling, Soil analysis, \*X-Ray analysis, \*Clams, \*River beds, Aquatic life, Shellfish, Cores, Core logging.

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5C-Effects Of Pollution

tests, Soil investigations, Testing procedures, Variability, Soil chemistry, Inorganic compounds, Analytical techniques, Finite element analysis, Illinois, "Illinois River.

A sediment core of material was taken from the bed of a Mississippi River tributary, the Illinois River, divided into 4 samples (A-D, ranging from upper to lower region of the core), and particle matter from each sample was characterized by mean size (2.8-5.3 microns), mass (44.1-78.1 millipgrams/liter), and concentration (2.8 million to 5.1 million particles (liter). Gill screen were isolated. million particles/liter). Gill props were isolated, and subsequent measurement of the effects of temand subsequent measurement of the effects of tem-perature on sediment-transport rate (mm/second) for the 4 samples were determined from dorsal to ventral border of the gill. The two samples (A and B) from the upper core regions produced a signifi-cant cilio-inhibitory effect. Elemental analysis showed slightly higher calcium in samples A and B, with significantly greater amounts of manganese and phosphorus in B. These results support the findings that the greatest chilio-inhibition occurred in region B. The sediments studied were deposited approximately in the mid-1950's, when fingernail clams disappeared from a 100-mile section of the claims disappeared from a 100-mile section of the Illinois River. Restoration of clam populations would dramatically increase fish production and diving duck activities, illustrating the importance of assessing sediment quality effects on lower or-ganisms. (Zieinski-IPA) W81-01903

SILICON SUBSTITUTION FOR CALCIUM IN THE SHELL OF THE FINGERNAIL CLAM, MUSCULIUM TRANSVERSUM STUDIED BY X-RAY ANALYSIS,

A-RAT ANALISIS, Southern Illinois Univ. at Carbondale. Center for Electron Microscopy. J. A. Murphy, A. Paparo, and R. Sparks. In: 38th Annual Proceedings, Electron Micros-copy Society of America, 1980, San Francisco, CA, p 560-561. 4 Fig. OWRT B-119-ILL(3).

Descriptors: "Water pollution effects, "Clams, "Calcium, "Silicates, "X-ray analysis, River beds, Sediments, Nutrients, Instrumentation, Mortality, Water quality, Research and development, Aquatic life, Shellfish, Aquatic animals, Illinois, Testing procedures, Sampling, Finite element analysis, Analytical techniques, Calcium compounds, "Illicit Blisses".

In the mid-1950's, fingernail clams disappeared from a 100-mile section of the Illinois River, a Mississippi River tributary. Factors in the river and/or sediment prevent clams from recolonizing areas where they were formally abundant. Experiment when the section of the control of the contr areas where they were formanly abundant. Experiments showed greatest clam mortality and highest incidence of shell deformations occurred in test chambers containing the highest proportion of river water to well water. The molluscan shell consists of calcium carbonate, probably derived from netabolic carbon dioxide. This study examined the role of raw river water and well water on shell formation in the fingernail clam. Normal fingernail clams from the Keokuk Pool of the Missis-sippi developed bizarre shell deformation and died siph developed using similar destination and used without reproducing after 4 weeks in well water containing a known composition of trace metals. X-ray analysis showed the principal component of the shells was calcium, in shell layers that were laid down when clams were still in the Mississippi. When clams were introduced to well water, shell calcium dropped and silicon became the predomi-nant element, particularly in the shell deformity area. It was concluded that the Ca/Si ratio in normal portions of clam shells is almost the reverse of that in deformed shell parts. (Zielinski-IPA) W81-01904

A RESEARCH STRATEGY FOR ANTICIPATING CONTAMINANT THREATS TO AQUATIC RESOURCES,

RESOURCES, Columbia National Fisheries Research Lab., MO. R. A. Schoettger, and J. L. Ludke. Available from the National Tecinnical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy. A01 in microfiche. In: Proceedings of the Third USA-USSR Sympo-

sium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 1-17. 8

Descriptors: \*Aquatic environment, Water pollution, \*Wildlife, \*Research priorities, Planning, Management, Project planning, Water pollution control, Pollution abatement, Aquatic life, Forecasting, Forecasting, \*Water pollution effects, \*Econstruction\*

The Environmental Contaminant Evaluation Pro-The Environmental Contaminant Evaluation Pro-gram of the Fish and Wildlife Service is emphasiz-ing a predictive approach to identify potential con-taminant problems and preventing or ameliorating adverse effects of contaminants on ecological systems. Because manpower and scientific resources are limited, the environmental research community are initied, the environmental research community must emphasize the necessity of placing priorities on fishery and wildlife resources. A strategy was developed that accentuates the anticipation of new or previously unrecognized pollution problems, while continuing to address old problems that remain a concern. The approach draws upon a remain a concern. The approach thaws upon a number of different sources to assist in the identifi-cation of present and potential contaminant effects. Information and data that relate to topics of concern are reviewed by scientists and resource man-agers to develop an overview of a problem and to determine data needs. A research design is then formulated to provide information on the real or potential effects a contaminant may have on aquatic organisms or ecosystems. Corrective or preventive alternatives that include one or more of the following may then be recommended: legislative action to regulate or prohibit the chemical; modifi-cation of management techniques; changes in the use of certain chemicals; substitute less harmful chemicals; selection of a less harmful activity or process. The stategy insures that resource managers are involved in the process of problem identification and formulation of research design, so that the objectives and results are applicable to the actual environmental problems that confront the aquatic resources. (Moore-SRC) W81-01906

PRINCIPLES OF ESTIMATION OF NORMAL AND PATHOLOGIC STATES OF RESERVOIRS WITH CHEMICAL POLLUTION,

Moscow State Univ. (USSR). Faculty of Biology

and Soil Science

N. S. Stroganov. Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Sympo-sium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 18-33. 4 Fig, 8 Ref.

Descriptors: \*Water pollution, Potable water, \*Aquatic life, \*Limnology, \*Reservoirs, \*Water pollution effects, Water quality, Commercial fish, Commercial shellfish, Water utilization, Aquatic environment

A need has been demonstrated for giving hydrobioloical principles priority over other principles in the evaluation of the status of a reservoir. Based on the requirements of a reservoir in terms of preserthe requirements of a reservoir in terms of preservation of hydrobiological processes assuring pure water of good quality and productivity of valuable commercial species, the following four principles should be used as a basis for standardization of water quality in fresh surface bodies of water: priority in the use of reservoirs; sufficient self-purification; assurance of life for commercial species suitability of water for drinking. Under all cies; suitability of water for drinking. Under all conditions, man is the main standard for evaluation of normality or abnormality of a body of water. It of normality or abnormality of a body of water. It is not simply the number and variety of species which are important, but rather useful species and their populations and productivity; not simply the stability of the system, but rather the stability of the required quality of the system. An aquatic ecosystem may be stable both with polysaprobic pollution and with oligosaprobic pollution, but

preference is given to the oligosaprobic state of a preterence is given to the oligosaprobic state of a reservoir over the polysaprobic state. For aquatic organisms, a normal body of water is that which best corresponds to their physiologic and biologic peculiarities. (Moore-SRC)

THEORETICAL ASPECTS OF THE 'NORMAL-CY AND PATHOLOGY' PROBLEM IN AQUATIC ECOTOXICOLOGY, Akademiya Nauk URSR, Kiev. Inst. Hidrobiolo-

L. P. Braginsky.

Available from the National Technical Information Service. Springfield. VA 22161 as PB80-226657, Service, Springlied, VA 22101 as PBs0-220037, Price codes: Al2 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borak, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 34-43. 9

Descriptors: \*Aquatic environment, \*Toxicity, \*Water pollution, \*Aquatic life, Ecosystems, En-tropy, Biological communities, Dominant organ-isms, Pathology, Water properties.

Ecotoxicology, a new trend in ecology, deals not with the individual organism response to toxic effects but with the response of the community and ecosystem, as well as the transformation of toxicants in natural ecosystems. The notions of normal and pathological states of aquatic ecosystems are closely associated with the whole complex of other ecological concepts such as preservation of homeoecological concepts such as preservation of homeo-stasis, transformation of community structure, a shift of dominant forms, disturbances of bio-geo-chemical cycles, system buffering, detoxification potential and, with the concept of entropy and negative entropy system. From this point of view, the study of the general problems of pathology of aquatic ecosystems is considered in the light of the second principle of thermodynamics. The consideration of the problem of detoxification of waters should then be from the view of life as a negatively entropic process, evoked by our planet to retain entropic process, evoked by our planet to retain energy, and to prevent its dispersion into space. The analysis of aquatic ecosystem responses to toxicant effects in the light of the second principle of thermodynamics may significantly stimulate our understanding of the destructive and reduction processes and factors, determining the stability and degradation of aquatic ecosystems, and the hydrobiosphere as a whole. (Moore-SRC) W81-01908

TRENDS IN AQUATIC TOXICOLOGY IN THE UNITED STATES: A PERSPECTIVE, Columbia National Fisheries Research Lab., MO.

F. L. Mayer, Jr., P. M. Mehrle, Jr., and R. A. Schoettger

Schoettger.

Available from the National Technical Information Service. Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Eccosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 44-59. 2 Fig. 1 Tab. 49 Ref Fig, 1 Tab, 49 Ref.

Descriptors: \*Toxicity, \*Aquatic environment, Descriptors: "Toxicity, "Aquatic environment, "Water pollution, "Ecosystems, Pesticide residues, Pesticides research priorities, Mining, Agriculture, Forestry, Sewage disposal, Invertebrates, Aquatic plants, Fish, Pesticide toxicity.

Research approaches are changing from acute toxicity testing and residue analysis to more complex and integrated research involving chronic toxicity, clinical chemistry, and ecosystem concepts. These approaches are resulting in assessments of the environmental hazard of contaminants, sometimes even before they enter the environment, rather than in the production of acute toxicity and residue data of only limited value. Developmental research is pro-viding better interpretation and shortcuts in toxicology. In ecosystem studies, scientists are deter-mining what really must be measured to assess the

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Effects Of Pollution—Group 5C

type and degree of pollution; biochemical techniques are decreasing the time required for chronic toxicity studies; and plants and invertebrates are being recognized for their importance to fish and aquatic ecosystems and are being tested accordingly. Recognition of the complexity of aquatic committees the control of the complexity of aquatic committees by the control of the complexity of aquatic control of the com in the company of aquatic con-taminant residues has led to increased emphasis on the development of integrated strategies for their detection and analysis. Research emphasis has shifted to the prediction of problems that may arise smitted to the prediction of problems that may arise as mining, smelting and coal conversion are increased, new methods of sewage disposal, petroleum and detergent use expands, and pesticides use changes inforest, range, and agricultural practices. (Moore-SRC) W81-01909

COMPARISON OF PRINCIPLES OF DEVEL-OPMENT AND USE OF WATER QUALITY STANDARDS IN THE USSR AND USA, Leningrad Research Inst. of Lake River and Fish-

ing Management (USSR).

ing Management (USSR).
L. A. Lesnikov.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-226657,
Price codes: A12 in paper copy, A01 in microfiche.
In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic
Ecosystems, July 2-6, 1979, Borok, Jaroslav1
Oblast, USSR, Environmental Protection Agency
Report EPA-600/9-80-034, July, 1980, p 60-74. 2
Tab 59 Ref.

Descriptors: \*Water quality standards, \*Toxicity, \*Aquatic life, \*Water pollution, \*Ecosystems, Aquatic animals, Fish, Algae, Plankton, Microorganisms, Invertebrates, Water chemistry, Aquatic environment, United States, Russia

In the USSR, about 600 sanitary-hygienic maximum permissible concentrations (MPC) have been developed for harmful substances, as well as 210 fishing industry MPC's. In the USA, reports have been published on the degree of harm of a similar number of substances, primarily from short-term experiments. In order for one nation to use data obtained by another nation it is necessary to gain come idea concerning the relative toxicity, exist. some idea concerning the relative toxicity resistance of test organisms. Representatives of local aquatic fauna are used both in the USSR and in the USA. Comparison of tests on fish, algae, zooplankton, benthic invertebrates, microorganisms, and hydrochemistry indicates that, with the exception nydrochemistry malcates mal, with the exception of a small number of tests, the studies in the two countries generally have the same goals, and are performed according to basically similar methods. The MPC system used in the USSR is equivalent in the nature of its scientific foundation to the concept of the water quality criterion used in the USA which the water apulity extracted used in the concept of the water quality criterion used in the USA, while the water quality standards used in the USA are more or less equivalent to the discharge norms or maximum permissible discharges used in the USSR. A classification of the relative toxicoresistance of test organisms used in the USSR and USA can be used to compare studies on the toxicity of water pollutants. (Moore-SRC) W81-01910

CHLORINATED HYDROCARBONS AS A LIMITING FACTOR IN THE REPRODUCTION OF LAKE TROUT IN LAKE MICHIGAN, National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.

MI. Great Lakes Fishery Lab.

W. A. Willford.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB80-226657,
Price codes: A12 in paper copy, A01 in microfiche.
In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic
Ecosystems, July 2-6, 1979, Borok, Jaroslavl
Dollast, USSR, Environmental Protection Agency
Report EPA-600/9-80-034, July, 1980, p 75-83. 2
Fig. 15 Ref.

Descriptors: \*Lake trout, \*Lake Michigan, \*Fish reproduction, \*DDE. \*Polychlorinated biphenyls, \*Toxicity, Chlorinated hydrocarbons, Pesticides, Fry, DDT, Fish stocking, Water pollution, Mortality, Pesticide residues, Fish physiology.

Due to an ongoing lake trout restocking program which began in 1965 in Lake Michigan, by the

early 1970's, the lake trout were once again considearly 1970's, the lake trout were once again considered abundant in Lake Michigan and spawning activity was widespread. Nevertheless, no naturally produced fingerlings or older lake trout have been found in the lake during sampling. The lake trout were known to contain substantial residues of DDT and its metabolites and of polychlorinated biphenyls, but the existing levels in eggs did not significantly affect survival in eggs or of early stages of the fry. Lake Michigan lake trout fry were exposed for 6 months to DDE and polychlorinated biphenyls at levels approximating exposure were exposed for 6 months to DDE and polychlo-rinated biphenyls at levels approximating exposure received by fish, and at concentrations 5 and 25 times these values, in water and food. The final cumulative mortality of fry in the simulated Lake Michigan exposure was 40.7%, or nearly double the final cumulative mortality of the controls. At the highest combined level of polychlorinated bi-phenyls and DDE tested, 46.5% of the fry died. During the chronic exposure, observations were made periodically on the growth, swimming performance, predator avoidance, temperature preference, and metabolism of the fry. In general, the ence, and metabolism of the try. In general, the exposed fry showed no significant physiological effects attributable to the exposure. The current levels of polychlorinated biphenyls and DDE in the lake appear sufficient to impede the restoration of self-sustaining populations of lake trout in Lake Michigan. (Moore-SRC) W81-01911

ORGANOPHOSPHORUS PESTICIDES AND THEIR HAZARDS TO AQUATIC ANIMALS, Akademiya Nauk SSSR, Moscow. Inst. Biologii

Akademiya Nauk SSSR, Moscow. Inst. Biologii Vnutrennykh Vod. V. I. Kozlovskaya, and B. A. Flerov. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy. A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 84-96. 4 Fig, 7 Tab, 25 Ref.

Descriptors: \*Organophosphorus pesticides, \*Toxicity, \*Invertebrates, \*Water pollution effects, Aquatic animals, Pesticides, Agricultural runoff, Enzymes, Animal physiology, Animal behavior, Aquatic environment

Organochlorine pesticides have been replaced with organophosphorus pesticides on the assumption that as a result of lower persistence in the aquatic that as a result of lower persistence in the aquatic environment, organophosphorus pesticides will be of little danger to aquatic organisms. However, organophosphorus pesticides have proven to be highly toxic to the majority of species of aquatic invertebrates. The concentrations found in some bodies of water greatly exceed lethal levels for sensitive species. The intensive application of organophosphorus pesticides as a part of agricultural practices results in a periodic influx of these pesticides into bodies of water. In natural waters, pollution levels are produced which cause chronic elements. tion levels are produced which cause chronic effects on aquatic animals. This is especially dangertects on aquatic animats. In its especiarity danger-ous because organophosphorus compounds possess an additive effect; and are poorly avoided by aquatic animals. An indicator of the effects of organophosphorus pesticides is an inhibition of cholinesterase in both acute and chronic intoxica-tion. In pathological processes, the inhibition of cholinesterase as a target enzyme undoubtedly plays a leading role, although death occurs when the inhibition of enzymes is still incomplete. the inhibition (Moore-SRC) W81-01912

MONITORING CONTAMINANT RESIDUES IN FRESHWATER FISHES IN THE UNITED STATES: THE NATIONAL PESTICIDE MONITORING PROGRAM,
Columbia National Fisheries Research Lab., MO. J. L. Ludke, and C. J. Schmitt.
Available from the National Technical Information Service. Springfield. VA 22161 as PB80-226657, Price codes: Al2 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl

Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 97-110. 4 Fig. 5 Tab.

Descriptors: \*Pesticides, \*Water pollution, \*Fish, Descriptors: "Pesticides, "Water pollution, "Fish, "Monitoring, Aquatic environment, DDT, Pesti-cide residues, Chlorinated hydrocarbon pesticides, Distribution, Polychlorinated biphenyls, Toxa-phene, Endrin, Dieldrin, Cadmium, Lead, Mer-cury, Arsenic, Selenium, Freshwater fish.

Monitoring contaminants in freshwater fish has undergone a series of changes since collections began in 1967. At first, fish were collected from 50 began in 1967. At first, fish were collected from 50 sampling stations in the Great Lakes and major rivers throughout the United States, in the spring and again in the fall. There are now 117 stations where fish are collected for analysis of contaminant residues. About half of the stations are sampled in the fall of even-numbered years and the other half during odd-numbered years and the other half during odd-numbered years. At each trend monitoring station, three samples of five fish each are taken: two samples of a bottom-dwelling species and one of a predator species. The number of contaminants studied has increased from 8 in 1967 to more than 20 today. Residues of DDT and tis metabolites in fish from the major rivers and 1967 to more than 20 today. Residues of DDT and tis metabolites in fish from the major rivers and lakes have shown a continuing downward trend. The number of sites where DDT has been observed in at least one sample has also decreased somewhat since 1970. Polychlorinated biphenyls have become virtually ubiquitous, reflecting the former widespread use of these persistent industrial compounds. Polychlorinated biphenyls occur in fish tigsize more frequently and at the highest fish tissues most frequently and at the highest concentration in the industrial northeastern and midwestern sections of the United States. Mean toxaphene residues are increasing in freshwater toxaphene restaues are increasing in Testiwater fishes, and toxaphene occurs much more widely now than in past years. Nationally, average resi-dues of dieldrin and endrin in fish tissues have remained essentially unchanged from 1970 through remained essentially unchanged from 1970 through 1977. The fish samples collected in 1977 were analyzed for cadmium, lead, mercury, arsenic and selenium. Background levels for the metals were determined, as well as geographic areas where these levels are exceeded. (Moore-SRC) W81-01913

ACCUMULATION AND METABOLISM OF PERSISTENT PESTICIDES IN FRESHWATER

Akademiya Nauk URSR, Kiev. Inst. Hidrobiolo-

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
F. Y. Komarovskiy, and A. Y. Malyarevskaya.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: Al2 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 111-117. 10 Ref.

Descriptors: \*DDT, \*Freshwater fish, \*Pesticide residues, \*Water pollution effects, DDE, DDD, Chlorinated organic pesticides, Metabolism, Daphnia, Food chains, Carp, Perches, Bream, Tubificids, Aquatic animals.

The accumulation and transformation of organochlorine pesticides, especially DDT has been well demonstrated in terrestrial and marine ecosystems, but has received little attention in freshwater eco-systems. Experimental efforts have been directed toward three major areas: a demonstration of the level of persistent pesticides in aquatic ecosystems and the organisms under examination; experiments in vitro to demonstrate the accumulation of residues of DDT and its metabolites in selected organs and tissues of fish, and to describe the development of intoxication in time; studies in experimental basins to establish accumulation and transformation odsins to establish a decumulation and trainstontation of persistent pesticides at different topic levels. The following fish species were used; bream, pike perch, pike, perch, carp, crucian carp, and silver carp. The food organisms tested include tubificids and daphnia. The concentrations of DDT, DDE and DDD in water were found to be in the parts per trillion and parts per billion range. Sedii

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#### Group 5C-Effects Of Pollution

values were in the range of parts per billion and parts per million. In freshwater fish, residual quan-tities of DDT and its metabolites are mainly accumulated in fatty and brain tissues. The predominance of DDE and DDD in storage indicates that DDT undergoes substantial changes. Toxicological symptoms appear in parallel with increasing levels of DDT in target organs, especially in the brain, when DDT and its metabolites accumulate up to 3 ppm in the brain tissue of fish, the fish die with obvious symptoms of cumulative toxicosis. In a food chain study it was found that tubificids metood chain study it was found that fubiliseds metabolize DDT only to DDD; daphnia to DDD and DDE, carp to DDD and DDE, and perch and pike to DDD and DDE, but at a different ratio. (Moore-SRC)
W81-01914

SOME FACTORS AFFECTING THE TOXICITY OF AMMONIA TO FISHES, Montana State Univ., Bozeman. Fisheries Bioassay

Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. V. Thurston.
Available from the National Technical Information
Service. Springfield, VA 22161 as PB80-226657,
Price codes: A12 in paper copy. A01 in microfiche.
In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic
Ecosystems, July 2-6, 1979. Borok, Jaroslavl
Oblast, USSR, Environmental Protection Agency
Report EPA-600/9-80-034, July, 1980, p 118-137. 7
Fig. 38 Ref.

Descriptors: \*Toxicity, \*Ammonia, \*Fish, Temperature, Dissolved oxygen, Hydrogen ion concentration, Environmental effects, Aquatic environment, Water pollution, Rainbow trout, Water quality standards, Acclimation.

Reported acute toxicity ammonia values for a variety of species of fishes range between 0.25 and 4 mg/liter un-ionized ammonia, and other manifestations have been reported at concentrations as low as 0.01 mg/liter. Some of the factors that increase or decrease the toxicity of ammonia are considered in relation to the water quality standard for ammo-nia. There is evidence that fish with a history of nia. There is evidence that fish with a history of prior acclimation to some sublethal concentration of ammonia are better able to withstand an acutely lethal concentration, at least for some period of hours and possibly days. A drop in temperature below some optimum range for a given species of fish may increase its susceptibility to ammonia toxicity. The available evidence that temperature, independent of its role in the aqueous ammonia equilibrium affects the toxicity of ammonia to fishes argues for further consideration of the relafishes argues for further consideration of the rela-tionship. For rainbow trout under bioassay conditions, there was a 30% decrease in the median lethal concentration of ammonia when the dissolved oxygen concentration dropped from 8 to 5 mg/liter. Results of tests in fish indicate that ionmg/liter. Results of tests in fish indicate that ionized ammonia may exert a heretofore unrecognized toxic effect on fish, or that the toxicity of unionized ammonia increases as the hydrogen ion concentration increases. These examples of how the many chemical and physical parameters involved in aqueous systems are interrelated in affecting the toxicity of a pollutant illustrate the complexities in establishing water quality criteria and setting standards. (Moore-SRC) W81-01915

THE PREDICTION OF THE EFFECTS OF POLLUTANTS ON AQUATIC ORGANISMS BASED ON THE DATA OF ACUTE TOXICITY

BASED ON THE DATA OF ACUTE TOXICITY EXPERIMENTS,
Moscow State Univ. (USSR). Faculty of Biology and Soil Science.

O. F. Filenko, and E. F. Isakes n.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6. 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 138-155. 5 Fig. 5 Tab. 8 Ref. Fig. 5 Tab. 8 Ref.

Descriptors: \*Toxicity, \*Water pollution, \*Daphnia, Aquatic animals. Invertebrates, Mortality.

Aquatic environment, Time, Water quality standards, Forecasting.

The increasing number of pollutants requires acceleration of the ability to assess their toxicity, and to determine acceptable levels in the environment. This requires a reduction in the length of experimental effort, and an increase in the reliability of the response. To test the reliability of acute toxicthe response. To test the reliability of acute toxicity tests for predicting the effects of pollutants, the
toxic effect of some potential water pollutants was
assessed by organism survival in Daphnia. Analysis
of the data from this experiment indicates that the
dynamics of the results of toxic influence for aquatic organisms can be shown as a combination of
simpler processes. The connection of mortality
with time, and the onset of given effects with concentration can best be described by power function equations. For evaluation of regression equations describing these statistically reliable rela-tionships, 3 to 4 experimental points are necessary. These equations can be used for determination of the effects of the pollutant on the organisms for a period that exceeds the duration of observation, and for concentrations that have not been experimentally investigated, including an approximation of acceptable concentrations of the pollutant in the aquatic environment. (Moore-SRC) W81-01916

AGE SPECIFICS OF SENSITIVITY AND RESISTANCE OF FISH TO ORGANIC AND IN-ORGANIC POISONS.

Akademiya Nauk SSSR, Moscow. Inst. Biologii

Vnutrennykh Vod. V. I. Lukyanenko.

V. I. Lukyanenko. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 156-170. 12 Ref.

Descriptors: \*Toxicity, \*Fish, \*Growth stages, \*Pesticides, Fish eggs, Fry, Larvae, Water pollution, Age, Heavy metals, Phenols, Metaphos, Yalan, Propanid, Cadmium, Cobalt.

Conflicting results have previously been obtained concerning the level of toxicoresistance of various stages of ontogenesis of fish, resulting from the different natures of the toxic substances studies, and the differences in mechanism of action of the organic and inorganic poisons. The dynamics of toxicoresistance was studied in embryos, larvae, and fry of rainbow trout, bream, zope, carp, Russian sturgeon, Caspian sturgeon, sterlet and giant stari sturgeon, caspian sturgeon, sterie and gains sturgeon. The toxic substances used represented a broad range of concentrations of phenol, metaphos, yalan and propanid as well as chlorides of cadmium and cobalt. The level of toxicoresistance cadmium and cobalt. The level of toxicoresistance is found to be determined not only by the direction and intensity of metabolic processes in fish in various stages of ontogenesis, but also by the nature of the toxic agent used. The resistance of many species of fish to many organic poisons decreases with ontogenetic development and reaches a minimum in sexually mature fish. The process is not uniform, and periods of high resistance alternate with periods of high resistance alternate of fish to ods of low resistance. The resistance of fish to inorganic poisons, and particularly heavy metal salts, is minimal in the larval and fry periods. The increased toxicoresistance of eggs make the use of eggs as test objects undesireable in studies of the toxicity of various substances and in biological testing of natural and waste waters; larvae and fry are preferable. (Moore-SRC)

SYNERGISTIC EFFECTS OF PHOSPHORUS AND HEAVY METAL LOADINGS ON GREAT AKES PHYTOPLANKTON,

Michigan Univ., Ann Arbor. Great Lakes Re-search Div. E. F. Stoermer, L. Sicko-Goad, and D. Lazinsky. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657. Price codes: A12 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 171-186. 11 Fig. 1 Tab, 17 Ref.

Descriptors: \*Great Lakes, Phosphorus, \*Heavy metals, \*Eutrophication, \*Phytoplankton, Algae. Limnology. Water pollution, Lead, Lake Huron, Nutrients, Phosphates, Chlorophyta, Cyanophyta, Diatoms, Chrysophyta, Polyphosphate bodies, \*Synergistic effects.

During an investigation of Saginaw Bay, it became apparent that certain species of phytoplankton were surviving transport out of the bay into Lake Huron, which was unexpected because the species have high nutrient requirements which cannot be satisfied in Lake Huron. Internal stores of phossatisfied in Lake Huron. Internal stores of prios-phorus in the form of polyphosphate bodies were found in these populations. X-ray analysis further showed that the polyphosphate bodies also con-tained appreciable quantities of lead. Observations were made on natural phytoplankton assemblages collected and fixed under field conditions, natural assemblages subjected to experimental nutrient and heavy metal additions in the laboratory; and popuassemblages subjected to experimental nutrient and heavy metal additions in the laboratory; and populations isolated from the lakes and maintained in the laboratory. The occurrence of polyphosphate bodies in eutrophication tolerant phytoplankton species was found to be widespread in Saginaw Bay, even in areas where the water showed low levels of dissolved phosphorus. Polyphosphate bodies were particularly apparent in cells of some of the potentially nuisance producing blue-green algae. Polyphosphate bodies were also found in green algae, diatoms, Chrysophyceae and Prymnesiophyceae. They were not found in Cryptophyceae and euglenoids. Polyphosphate accumulation may be triggered by deficiency in some critical nutrient in the presence of excess exogenous phosphorus, stress invoked by excess levels of micronurients, or simply by the restoration of excess exogenous phosphorus to cells previously stressed by deficiency of phosphorus. Any or all of these conditions are apt to be present in mixing zones where contaminated stream flows enter the Laurentian Great Lakes. Phosphorus bound in polyphosphate contaminated stream flows enter the Laurentian Great Lakes. Phosphorus bound in polyphosphate bodies may be transported out into the open waters of the lakes, as may be lead. This may be an important mechanism of pollutant dispersal in the Laurentian Great Lakes. (Moore-SRC) W81-01918

REVERSIBILITY OF INTOXICATION AND FACTORS GOVERNING IT,

Akademiya Nauk SSSR, Petrozavodsk. Dept. of Water Problems.

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Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy, A01 in microfiche.
In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 187-200. 2
Fig. 8 Tab. 9 Ref Fig. 8 Tab, 9 Ref.

Descriptors: \*Toxicity, \*Fish, \*Waste water(Pollution), Water pollution effects, Pulp wastes, Sewage effluents, Temperature, Time, Fish physiology, Aquatic environment, Growth stages, \*Fish management.

The possibility of reversibility of intoxication is important in predicting results for organisms that undergo short duration exposure in the polluted undergo short duration exposure in the pointed zone during crises, and in the case of salvo dis-charges. Atlantic salmon, cisco, roach, perch, and pike were exposed to both concentrated and dilute waste waters and then transfered to pure lake water after signs of intoxication appeared, in order to determine the degree of reversibility of intoxication. The study employed unpurified multi-component wastes from sulfate pulp production, sewage from sulfate pulp production, sewage treatment plants, and wastes from heat and power stations. Fish of the first year of life were used. The main sign of intoxication, which served as a

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

signal for transferring fish to pure water, was most often the loss of the equilibrium relfex, and a transition to the inverted state. In some cases, the fish were subjected to a sequence of two to four exposures in the waste waters. The degree and dynamics of intoxication reversibility depended upon the temperature, the concentration of toxi-cants, the duration of exposure, the test species, and the age of the fish. Even brief exposure to sulfate-cellulose discharges, with subsequent mi-gration to pure water, does not guarantee fish safety, and can be especially dangerous when combined with high temperature regimes. (Moore-SRC) W81-01919

ASPECTS OF THE INTERACTION BETWEEN BENTHOS AND SEDIMENTS IN THE NORTH AMERICAN GREAT LAKES AND EFFECTS OF TOXICANT EXPOSURES,

Michigan Univ., Ann Arbor. Great Lakes Research Div.

J. A. Robbins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-660/9-80-034, July, 1980, p 201-225.
13 Fig, 3 Tab, 19 Ref.

Descriptors: \*Great Lakes, \*Benthos, \*Sediments, \*Water pollution effects, Nutrient cycling, Sedi-ment transport, Oligochaetes, Amphipods, Lake Huron, Diptera, Larvae, Silicon.

Fine-grained sediments are both the ultimate sink and partial source of nutrients in the Great Lakes, and the life activities of the benthos are likely to be an important factor in the nutrient cycle. If the behavior, physiology, or mortality of benthos are affected by aquatic pollutants, there can be poten-tially novel and important effects on major nutrient regulated aquarium. A gamma detector scanned the cells at daily or weekly interest action. the cells at daily or weekly intervals over a period of several months to determine how oligochaete worms or amphipods transported labeled particles away from the sediment surface. The oligochaetes rework the sediments by burial, while the amphipods burrow randomly from the surface, and move the particles in a manner akin to eddy diffusion. By the particles in a manner akin to eddy diffusion. By using both cesium-137, and the relatively conservation gamma emitting isotope sodium-22, reworking rates and molecular diffusion rates were determined simultaneously for cells with and without oligochaetes, it was found that the presence of tubificid worms at a density of about 70,000 per square meter enhances the diffusion coefficient by a factor of over three. Based on studies of benthos density and silicon flux in Lake Huron, chironomid larvae may play a major role in the regeneration of silicon from sediments, at least in shallow waters where fine-grained sediments can be found. (Moore-SRC)
W81-01920

RECENT ADVANCES IN THE STUDY OF NITRITE TOXICITY TO FISHES,

Montana State Univ. Bozeman. Fisheries Bioassay

Lab. R. C. Russo

R. C. Russo.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226657, Price codes: A12 in paper copy, A01 in microfiche. In: Proceedings of the Third USA-USSR Symposium on the Effects of Pollutants upon Aquatic Ecosystems, July 2-6, 1979, Borok, Jaroslavl Oblast, USSR, Environmental Protection Agency Report EPA-600/9-80-034, July, 1980, p 226-240. 6 Fig, 2 Tab, 25 Ref.

Descriptors: \*Toxicity, \*Fish. \*Nitrites, Water pollution effects, Water chemistry, Hydrogen ion concentration, Nitrous acid, Rainbow trout, Growth

stages, Chlorides, Calcium, Sea water, Methemoglobinemia.

Nitrite is produced as an intermediate product in the nitrification process and under some circum-stances may be present in natural waters at levels high enough to be deleterious to freshwater life. Concentrations as low as 0.2 mg/l nitrite-nitrogen Concentrations as low as 0.2 mg/1 infirin-infrogen are acutely lethal to several species of fish, while some species can tolerate short-term exposures to concentrations of 67 to 100 mg/l. In 20 96-hour nitrite bioassays on rainbow trout over the size nitrite bioassays on rainbow frout over the size range 2 to 387 g, no relationship between fish size and susceptibility to nitrite was found. A significant reduction in nitrite toxicity results from increased levels of chloride ion, and other anions also exhibit, in different degrees, an inhibitory effect on nitrite toxicity. Calcium and seawater also decrease the toxicity of nitrite. An additional factor that should be considered is the pH of the solution. The toxicity of nitrite to rainbow trout was studied over the pH range 6.4 to 9.0 to examine the effect of pH, and to determine whether toxicity could be attributed to the nitrous acid toxicity could be attributed to the nitrous acid concentration. Results suggest that neither chemical species alone is responsible for the entire toxicity. The toxicity of nitrite decreases with increasing pH. Methemoglobinemia is considered to be one mechanism by which nitrite is toxic to fishes, but it is probably not the only mode of toxic action. (Moore-SRC) W81-01921

IONOPHORE-MEDIATED CALCIUM CON-TROL OF CILIARY ARREST IN THE FINGER-NAIL CLAM, MUSCULIUM TRANSVERSUM, Southern Illinois Univ. at Carbondale.

A. A. Paparo, K. Cunningham-Paparo, and R

Comparative Biochemistry and Physiology, Vol 66A, p 355-357, 1980. 4 Fig. 11 Ref. OWRT-B-119-ILL(2).

Descriptors: "Clams, "Calcium, "Inorganic compounds, "Biocontrol, "Metabolism, Biochemistry, Aquatic life, Aquatic animals, Chemcontrol, Inhibitors, Ion transport, Cations, Nutrients, Water quality, Chemical analysis, Membrane processes, Essential nutrients, Biology, Biological properties, Laboratory tests, Research and Development, Illi-

The role of cytoplasmic calcium (Ca) concentra-tion in producing lateral ciliary arrest was exam-ined. Lateral cilia on the gill of the title fingernail clam normally have a metachronal rhythm beat. This rhythm is maintained or restored in the presence of 10.0 millimolar (mM) calcium chloride, or ence of 10.0 millimotar (mM) calcium entorde, or 15 mM potassium or sodium chloride. Lateral cili-ary arrest occurred when the gill perfusion con-tained 10 mM calcium chloride and 0.01 mM (small clams) or 0.001 mM (large clams) of A23187, a calcium ionophore. Arrest was not pro-duced in either calcium chloride or ionophore and monovalent cations alone. The results demonstrat-ed the important role of intracellular Ca concentration on the behavior of lateral cilia. The physiological significance seems to be momentary or complete shut-down of water currents under unfa-vorable environmental conditions. The sensitivity vorane environmental conditions. The sensitivity to Ca membrane permeability appears to increase with age of animal. The clams were taken from Keokuk Pool of the Mississippi River. (Zielinski-IPA)
W81-01945

THE REGULATION OF INTRACELLULAR CALCIUM AND THE RELEASE OF NEURO-TRANSMITTERS IN THE MUSSEL, MYTILUS EDITIS

Southern Illinois Univ. at Carbondale.

Comparative Biochemistry and Physiology, Vol 66A, p 517-520, 1980. 10 Fig. 15 Ref. OWRT B-119-ILL(7).

Descriptors: \*Electric currents, Biochemistry, \*Calcium, Mode of action, Organic compounds, \*Nutrient requirements, \*Mussels, Aquatic life, Shellfish, Chemoontrol, Metabolism, Inhibitors, Biocontrol, Biology, Biological properties, Inor-

ganic compounds, Ion transport, Cations, Nutri-ents, Essential nutrients, Chemical analysis, Ions, Aquatic animals, Membrane processes, \*Mytilus

Electrical stimulation of the bronchial nerve has been shown to activate lateral cilia by release of cilio-excitatory 5-hydroxytryptamine (5-HT). This nerve also appears to contain axons with 3, 4-dihydroxyphenylethylamine (DA) which functions as an inhibitory neurotransmitter. The present study examined the effect of calcium (Ca) on enstudy examined the effect of calcium (Ca) on endogenous and exogenous presence of the 5-HT and DA neurotransmitters. Lateral ciliary activity (CA) was studied on isolated visceral ganglion/bronchial nerve/gill preparations of this mussel. Bronchial nerve stimulation with 5 pulses/second (PPS) and 5-HT perfusion each accelerated ciliary beating; stimulation with 50 PPS and DA perfusion each inhibited CA. A decrease in external free Ca ion concentration or interference with Ca mem-brane permeability blocked nerve stimulation (low and high frequency) and subsequent endogenous release of neurotransmitters. Exogenous applica-tion of 5-HT and DA was not blocked by manipulation of Ca concentrations or Ca membrane interactions. It was concluded that Ca plays a critical role in regulation of presynaptic nerve terminal release of 5-HT and DA. (Zielinski-IPA) W81-01946

CILIO-INHIBITORY EFFECTS OF BRONCHI-AL NERVE STIMULATION, DOPAMINE, PENTYLENETETRAZOLE AND VISIBLE LIGHT IN THE MUSSEL, MYTILUS EDULIS, Southern Illinois Univ. at Carbondale

Comparative Biochemistry and Physiology, Vol 66C, p 249-253, 1980. 14 Fig, 21 Ref. OWRT B-119-ILL(6).

Descriptors: \*Inhibitors, \*Electric currents, \*Cal-cium, \*Biochemistry, \*Mussels, \*Mode of action, \*Nutrient requirements, \*Organic compounds, \*Light shellfish, Aquatic animals, Metabolism, Bio-control, Chemcontrol, Inorganic compounds, Ion transport, Cations, Nutrients, Chemical analysis, Ions, Aquatic life, Membrane processes, Labora-tory tests, \*Mytilus edulis.

Cilio-inhibition (CI) had been reported to occur in response to continuous stimulation of the bronchial nerve, manifested by a gradual decline in the rate nerve, manifested by a gradual decline in the rate of beating. It was recently shown that both high frequency and visible (490 mm) light release dopamine (DA) which leads to transformations in yellow-carotino-protein (neuronal pigment), and that pentyleneterazole (PTZ) markedly depleted lipochondria of calcium (Ca). The present study sought to demonstrate whether high frequency (50 Hz), visible light. DA and PTZ produce CI by causing release of sequestered Ca from lipochrondia. Lateral ciliary activity was observed in intact and isolated cell preparations. High frequency electrical stimulation, DA, PTZ and visible light produced CL CI produced by high frequency stimelectrical stimulation, DA, PTZ and visible light produced CI. CI produced by high frequency stimulation and photoactivation were blocked by ethylene glycol-bio(amino-ethyl ether)-NI,NZ-tetracetic acid (EGBTA) and lanthanum. DA and PTZ caused a similar gradual CI as observed with high frequency stimulation and photoactivation, but DA and PTZ were not blocked by EGBTA and lanthanum. All of the CI agents studied seemed to increase cellular Ca concentration causing normal dense granules containing Ca to alter into membranus granules with subsequent release of Ca. (Zienaus et al. Zienaus nous granu linski-IPA) rules with subsequent release of Ca. (Zie-W81-01947

HEAVY METALS AND MARINE DIATOMS; INFLUENCE OF DISSOLVED ORGANIC COM-POUNDS ON TOXICITY AND SELECTION FOR METAL TOLERANCE AMONG FOUR

SPECIES, Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Lab.

N. S. Fisher, and D. Frood.

Marine Biology, Vol 59, No 2, p 85-93, 1980, 2 Fig. 7 Tab, 66 Ref.

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5C-Effects Of Pollution

Descriptors: "Heavy metals, "Diatoms, "Resistance, Copper, Zinc, Cadmium, Organic compounds, Toxicity, Aquatic plants, Metals, Chelation, Water pollution effects, Marine plants, Phytoplankton, Corio Bay(Australia), Hobson's Say(Australia), Bass Strait(Australia), "Australia.

Clones from diatoms living in water chronically contaminated with heavy metals were generally less tolerant of copper, zinc, and cadmium additions than clones from the same species living in the 'dirty' water mediated the toxic effects of the metals. 'Dirty' water clones were especially subject to metal toxicity when in 'clean' water which contained low levels of dissolved organic compounds. Four species were tested in the heavy metal contaminated waters of Corio Bay, Australia, and of the relatively clean water Bass Strait. Copper was the most highly chelated and toxic; cadmium the least chelated and toxic. (Cassar-FRC)

EPIPELIC ALGAL COMMUNITIES IN A EU-TROPHIC NORTHERN LAKE CONTAMINAT-ED WITH MINE WASTES,

Alberta Environmental Center, Vegreville.
J. W. Moore.
Water Research, Vol 15, No 1, p 97-105, Ja

Water Research, Vol 15, No 1, p 97-105, January, 1981. 2 Fig, 3 Tab, 32 Ref.

Descriptors: \*Algae. \*Water pollution effects, \*Mine wastes, Water pollution, Eutrophication, Biological communities, Lakes, Heavy metals, \*Lake sediments, Canada, Subarretic, \*Eutrophic lakes, Canada, Thompson(Alberta).

The impact of contaminated sediments on the density, species composition and diversity of benthic algal communities was examined in a small lake (Thompson Lake) located in the Canadian subarctic. Investigations were carried out at different sampling stations from April to November of 1978. Sediments in this shallow, eutrophic lake had become contaminated with wastes from gold mining activities on the southeast shore which were conducted from 1941 to 1949. Near the former mine site, total mercury, copper, lead and zinc averaged 440, 85, 30, and 115 milligrams/kilogram, respectively, but their concentrations decreased rapidly as distance from the mine increased. At distances of 2.1-3.0 km from the mine levels of these metals were similar to background readings. Algal densities in the areas of heaviest contamination were only 50% of those found in other sites of the lake. Differences were also noted in the main species of algae found near the mine zone and algae sampled at stations 1.1-3.0 km away. Seasonal growth patterns were generally uniform throughout the lake. It was concluded that long term effects of mine wastes on epipelic algae were possible in northern aquatic systems and were similar to those observed in temperate zone lakes. However, no species or group of species could be designated as bioindicators of lake pollution by heavy metals. (Geiger-FRC)

CHANGES IN THE DENSITY OF ZOOPLANK-TON PASSING THROUGH THE COOLING SYSTEM OF A POWER-GENERATING PLANT, Australian Atomic Energy Commission, Sutherland

R. D. Simpson, and A. Dudaitis. Water Research, Vol 15, No 1, p 133-138, January, 1981. 3 Fig, 3 Tab, 12 Ref.

Descriptors: "Zooplankton, "Aquatic populations, "Cooling water, Copepods, Water temperature, Australia, "Electric powerplants, Water cooling, Water pollution sources, "Ecology, Environmental effects, Mollusks, Non-consumptive use, Intakes, Outlets.

Since zooplankton are important organisms in aquatic food chains, the effects of electric power plant cooling systems on these aquatic species have been investigated. A method was devised to sample the number and species types of plankton throughtout the water column at the inlet and

outlet of a power generating plant cooling system to determine if differences occurred as a result of cooling water intake operations. The technique was applied at a New South Wales coastal power station which is situated on a lake system consisting of Lake Munmorah and Lake Tuggerah, with an outlet to the sea. Specimens of copepods, copepod nauplii, barnacle nauplii, and bivalve larvae were collected by raising and lowering a net sampler through the water column. No significant changes in copepod densities were recorded after passage through the cooling system. Copepod nauplii and bivalve larvae became less abundant and barnacle nauplii more abundant after passage through the cooling system. These findings were attributed to the great rate of attachment of barnacles (which produce the nauplii) to both the inlet and outlet canals and the upsetting of copepod nauplii and bivalve larvae by the mechanical action of the pumping units. (Geiger-FRC) W81-01986

RESPONSES OF SUBMERSED VASCULAR PLANT COMMUNITIES TO ENVIRONMENTAL CHANGE,

East Carolina Univ., Greenville, NC. Dept. of Biology.
G. J. Davis, and M. M. Brinson.

G. J. Davis, and M. M. Brinson.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-164923,
Price codes: A05 in paper copy, A01 in microfiche.
Fish and Wildlife Service, Biological Services Program Report FWS/OBS-79/33, August, 1980. 79
p. 9 Fig, 4 Tab, 136 Ref, 2 Append. 14-16-0009-78-

Descriptors: \*Submerged plants, \*Aquatic plants, \*Aquatic environment, \*Light, \*Turbidity, Eutrophication, Light penetration, Water pollution effects, Secchi disks, Depth, Lakes, Photosynthesis, Light intensity.

Submersed vascular plants are native to many aquatic ecosystems where they influence a number of ecosystem processes and provide food and shelter for fish and wildlife. The response of submersed vascular plants to the following environmental conditions was reviewed: fluctuating water levels, currents and waves, suspended sediments, growing season, dormancy, nutrient availability, plantanimal interactions, and light conditions. Data were assembled on depth distribution records of submersed angiosperms and the Secchi transparencies of water for mostly North American lakes. Laboratory and field studies generally show that most shade tolerant species have a rapid photosynthetic response to increasing light in the low range of intensities. In clear shallow waters, the competitive advantage is shifted toward species in which photosynthesis is saturated only by extremely high light intensities. Further analysis of depth distribution patterns of species and water transparency allowed identification of turbidity tolerant and non-tolerant species. Based on long term studies of northern lakes, a survival index for submersed species was developed. The possible effects of human activities on alterations in aquatic ecosystems and an array of impacts on submersed plant communities are considered. (Moore-SRC)

#### FEEDING IN ZOOPLANKTON,

C. H. D. Magadza.
The Zimbabwe Rhodesia Science News, Vol 13, No 7, p 163-164, July, 1979.

Descriptors: \*Africa, \*Eutrophication, \*Zooplankton, \*Aquatic algae, Chydorus, Daphnia, Scenedesmus, Microcystis, Nutrients, Lake stages, Biomass, Particle size, Microorganisms, Water pollution

The hypothesis that one possible result of increased nutrient levels in water is the formation of algal colonies which are too large for filter feeding zooplankton was tested using cultures of Daphnia and Chydorus. Both single and mixed algal populations were exposed to the animals to determine the various size ranges that they are capable of filtering. A Coulter Counter was used to determine algal number and particle size. Chydorus was able

to cope with particles ranging from 2 to just under 4 microns with small particles being preferred. Chydorus was almost unable to filter a culture of Scenedesmus which has a size range of 12 to 30 microns. Daphnia preferred particles ranging from 15 to 25 microns. A mixed population of Chydorus and Daphnia were also exposed to Microcystis, an algae causing major problems in Lake Mcllwaine in Africa. Both animals were unable to utilize Microcystis to any significant degree. The broad impressions of these preliminary results support the pattern of increasing algal numbers and declining zooplankton numbers in eutrophic waters. (Seigler-IPA)

WATERBORNE DISEASE; OCCURRENCE IS ON THE UPSWING,

Health Effects Research Lab., Cincinnati, OH.

Journal of the American Water Works Association, Vol 73, No 1, p 57-62, January, 1981. 2 Fig, 2 Tab, 9 Ref.

Descriptors: \*Public health, \*Epidemiology, \*Diseases, \*Water pollution, Human diseases, Potable water, Recreation, Sewage effluents, Water purification, Chlorination, Water quality, Water pollution sources, Brevard, North Carolina, Lake Havasu City, Arizona, Bradford, Pennsylvania, Coliforms, State parks, Water wells, Beavers, Septic tanks.

Deficiencies in water treatment practices and plant operation were the causes of three outbreaks of waterborne disease during 1979. Beavers infected with giardiasis were the source of an epidemic of diarrheal illness affecting at least 2900 people in Bradford, Pennsylvania. Antiquated, inadequate chlorination equipment allowed nonchlorinated water to be delivered during 15 minute cylinder changes. In addition, sampling for residual chlorine was done too near the injection point, giving misleading high readings and resulting in low doses of chlorine. In this case, all components of the multiple barrier system had failed. After many visitors to the Cattail Cove State Park at Lake Havasu City, Arizona, became ill, dye tests revealed a connection between the sewage effluent plant and the potable water system. Since the same type and color of pipe was used for the effluent irrigation system as for the potable water supply and 4 owners modified the system during 6 years, conditions were optimum for contamination. This case points out the fact that regulatory agencies frequently neglect non-community systems, which often need the most attention. The Wilds, a church camp in Brevard, North Carolina, closed after widespread gastrointestinal illness occurred. Although dye tests showed no connection of broken septic tanks and other possible sources of sewage contamination to the water supply, it was believed that channels in the limestone had become clogged, preventing the dye from entering during the test. This was an example of difficulty encountered in using untreated water. Waterborne disease outbreaks totaled 45 in 1979. Average outbreaks per year in the past were 36 during 1976-1979, 24 during 1971-1975, and 10 during 1951-1955. W81-02075

EUTROPHICATION IN EMILIA-ROMAGNA COASTAL WATERS (NORTH ADRIATIC SEA, ITALY): A CASE HISTORY,

Instituto di Ricerca Sulle Acque, Brugherio (Italy). G. Chiaudani, R. Marchetti, and M. Vighi. Progress in Water Technology, Vol 12, No 1, p 185-192, 1980. 7 Fig, 3 Tab.

Descriptors: "Sea water, "Eutrophication, "Benthic fauna, "Phosphorus, "Water pollution effects, Nitrogen, Coasts, Rivers, Water quality, Fertilizers, Farm wastes, Europe, Italy, Mediterra-

Eutrophication phenomena in the Emilia-Romagna coastal area of the Mediterranean were found to be caused by phosphorus pollution. The distribution of nutrients in area waters was determined. The

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution-Group 5C

area receives a total of 19,000 metric tons of phosphorus and 152,000 metric tons of nitrogen from various sources. The distribution of these nutrients matched the distribution of algal biomass. Diatoms developed in the northern areas near the mouth of the Po River. Dinoflagellates bloomed in strictly coastal waters. A strategy to prevent eutrophica-tion is presented. Total phosphorus could be re-duced to 5% of its present level if 95% of urban, zootechnical, and industrial wastes were removed and if fertilizers were used more sparingly. The study took place in 1976-78. (Small-FRC) W81-02086

MICROCOSM SYSTEM STUDY OF ALGAL BLOOM FORMATION.

National Inst. for Environmental Studies, Yatabe (Japan). Lab. of Freshwater Environment.

M. Okada, and R. Sudo

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 1029-1034, May, 1980. 8 Fig, 12

Descriptors: \*Cyanophyta, \*Eutrophication, \*Microcosm studies, \*Algae, Laboratory studies, Biomass, Diurnal, Microcystis aeruginosa, Microcystis

To overcome the complicating factors of field studies and the oversimplification of laboratory studies, a microcosm system, intermediate between the two, was devised to study algal blooms. The system consists of Microcosm A, 2 tanks, and Microcosm B, 5 tanks, with associated tanks, pipelines, control systems, sterilizing equipment, computer, etc. Microcosm A is used for studying the photic zone and B for the aphotic zone. It is possible to alter growing conditions to simulate thermoclines, Langmuir circulation, air-water gas exchange, and diurnal variations. Growth curves for Microcystis aeruginosa were obtained at different depths (0.3 meters to 3.0 meters) without thermal stratification. On the 20 to 27th days, a bloom was present on the surface, followed by a sudden was present on the surface, followed by a sudden collapse. Similar studies on Microcystis flos-aquae with thermal stratification showed an algal biomass 10 times greater in the upper layers compared with the deeper layer. Rates of population growth were significantly less than in flask culture. Although little diurnal variation of dissolved oxygen was observed, a large vertical change was seen, and the concentration at a depth of 2 meters was 2 mg per liter. (Cassar-FRC) W81-02095

THE LOADING CONCEPT AS BASIS FOR CONTROLLING EUTROPHICATION: PHI-LOSOPHY AND PRELIMINARY RESULTS OF THE OECD PROGRAMME ON EUTROPHICA-

Canada Centre for Inland Waters, Burlington (On-

R. A. Vollenweider, and J. Kerekes.

Progress in Water Technology, Vol 12, No 2, p 5-38, 1980. 6 Fig, 3 Tab, 31 Ref.

Descriptors: \*Eutrophication, Control, \*Interna-tional commissions, \*Data collections, Phosphorus, Lakes, Mathematical models, North America,

A major cooperative program involving 18 countries and including more than 50 research centers was developed to provide a sufficiently large body of comparable data to permit the derivation of quantitative relationships between loading and eutrophication of lakes. The four projects which make up the program are: an alpine project, a northern project, a reservoir and shallow lake project, and a North American project. Standard parameters for measuring and monitoring eutrophication have been established. One preliminary result is a confirmation that in 70 to 80% of the cases studied so far, phosphorus was found to be the production-controlling factor. A relationship is being studied between lake phosphorus levels and loading estimates, and Dillon's and Vollenweider's models are presented. (Small-FRC) W81-02121

MARINE STUDIES ON A COASTLINE WITH SEWAGE OUTFALLS,

Techniche Eliminazione Inquinamenti, Milan (Italy). P. G. Vigliani, B. Sclavi, A. Visconti, and G. F.

Progress in Water Technology, Vol 12, No 1, p 145-162, 1980. 11 Fig. 5 Tab.

Descriptors: \*Water pollution effects, \*Outfall sewers, \*Sewage, \*Sea water, \*Water properties, Water quality, Phytoplankton, Benthic fauna, Coliforms, Biochemical oxygen demand, Chemical oxygen demand, Turbidity, \*Italy, Mediterranean.

A 90 km long section of the Italian coast with five A 50 km long section of the fathan coast with five existing sewage outfalls was investigated to deter-mine the short and long term effects of discharges on the environment. Sea water and sewage/water mixtures were tested for current velocity and direction, depth, temperature, turbidity, dissolved oxygen, silicates, chlorides, salinity, pH, suspended oxygen, silicates, chlorides, salinity, pH, suspended solids, BODS, COD, nitrogen, phosphates, oils and greases, coliforms, benthos, and phytoplankton. Measurements were made during periods of normal and maximum pollution load. Minimum initial dilutions measured at the plumes were 1:19 for the outfall Anzio Capoluogo, 1:25 for Torvaianica, 1:43 for Nettuno, and 1:65 for Anzio valanica, 1345 for Nettuno, and 1355 for Alizio Bottaccio. The concentration of dissolved oxygen around the plume was also close to or greater than saturation, and entrapments of the discharge almost never occurred. Bacteria die-off rates in the sewage/sea water mixture averaged T90 of 1.65 hr and a minimum of approximately 1 hr. The mini-mum time of return-to-shore varied from 0.7 hr to mum time of return-to-snore varied from 0.7 fr to 3.1 hr. Benthic and phytoplankton studies indicat-ed that the pollution had a slight effect on the ecosystem of the area. (Small-FRC) W81-02126

EFFECT OF CONSTRUCTION AND USE OF A HARBOR-INDUSTRIAL COMPLEX ON THE DISTRIBUTION AND EVOLUTION OF THE BENTHIC POPULATION OF A MEDITERRANEAN GULF (GULF OF FOS), (INFLUENCE DE LA CONSTRUCTION ET L'EXPLOITATION D'UN COMPLEXE PORTUAIRE ET IN-TION D'UN COMPLEXE PORTUAIRE ET IN-DUSTRIEL SUR LA DISTRIBUTION ET L'E-VOLUTION DES PEUPLEMENTS BENTHI-QUES LITTORAUZ D'UN GOLFE MEDITER-RANEEN (GOLFE DE FOS)),

Centre d'Oceanographie, Marseille (France). Sta-

G. Stora, and J. C. Romano.

Progress in Water Technology, Vol 12, No 1, p 137-144, 1980. 3 Fig, 8 Ref.

Descriptors: Sedimentology, \*Benthic fauna Sewage, \*Excavation, \*Construction, Effects, \*Industrial wastes, Bioindicators, \*Harbors, Water pollution sources, Gulf of Fos, \*Mediterranean.

The effects of the construction and operation of a harbor and industrial complex on the benthic fauna of the Gulf of Fos were studied from 1964 through 1978. Construction (1964-1972), which included digging of the harbor, caused sedimentary instability, and only a few benthic species were found. In 1975, three years after the last construction work, species adapted to silting bottoms had replaced benthic fauna originally found in the area. There centric tauna originally found in the area. There was an increase in pollution indicator species, indicating that the expected degradation of the environment had occurred. The sewage from the harbor and industrial complex are added to the sewage already in the Gulf, resulting in more Gulf pollution. (Small-FRC) W81-02130

PREDICTION OF THE CALCIUM CARBON-ATE SATURATION PH IN COOLING WATER, Houston Univ., TX. Dept. of Civil Engineering. L. M. McGaughey, and J. V. Matson. Water Research, Vol 14, No 12, p 1729-1735, De-cember, 1980. 5 Fig. 5 Tab, 16 Ref.

Descriptors: \*Mathematical studies, \*Cooling water, \*Calcium carbonate, Computer models, Model studies, \*Hydrogen ion concentration, Industrial wastes, Equations, Waste water, Minerals, Salinity, Sulfates, Ions.

In 1936, the Langelier pHs equation was formulated to estimate the pH at which a water would be in equilibrium with CaCO3. A mathematical study was performed to quantify the extent of ion association in waters typical of open recirculating cooling systems, to derive a theoretical term for the Langelier pHs equation to explain significant calcium complexation, and to develop a method to amend the original Langelier equation to bring it in line with current theory. A computer model was used to solve the simultaneous equations describing the industrial cooling water systems investigated. When sulfate levels were approximately 1000 peop. the industrial cooling water systems investigated. When sulfate levels were approximately 1000 ppm, the calculated pHs was considerably altered. To correct for this, a predictive technique was proposed, wherein a system would be operated at a higher pH or at the same pH with higher calcium concentrations. The first option offers economic concentrations. The first option offers economic savings by reducing acid consumption, while the second option would afford reduced waste water production by maintaining higher dissolved mineral levels. The proposed correction should offer accurate results for pH ranges of 6.5-9.7 and ionic strengths of up to 0.5 M. (Geiger-FRC) W81-02135

A STEADY STATE EUTROPHICATION MODEL FOR LAKES,

Iowa Univ., Iowa City. Dept. of Civil (Environ-mental) Engineering.

J. L. Schnoor, and D. J. O'Connor. Water Research, Vol 14, No 11, p 1651-1665, November, 1980. 9 Fig, 2 Tab, 28 Ref.

Descriptors: \*Eutrophication, \*Model studies, \*Northeast U.S., \*Lakes, Great Lakes Region, \*Lake Ontario, Mathematical models, Hydrolysis, Sedimentation rates, Phosphorus, Nutrients, Water management, Kinetics, Mathematical studies, Phytoplankton, LBJ Lake, Texas.

An alternate approach to eutrophication modeling is presented which simplifies assumptions of the kinetic and transport equations. Both steady and non-steady state cases were studied for LBJ Lake, Texas (a short detention time reservoir) and Lake Ontario (a long detention time reservoir). Steady State solutions are also given for 81 of the phospho-rus-limited lakes of the US National Eutrophica-tion Survey. Use of the model requires the estima-tion of the sedimentation, hydrolysis, autocatalytic growth, and death rate constants. The sedimenta-tion rate constant determines the amount of phostion rate constant determines the amount of phosphorus lost to the deep sediment, and the total phosphorus levels of the lake. The other three constants control the partitioning of nutrients among the various organic, inorganic, and phytoplankton fractions. In the lakes sampled in the northeast and north central United States, phytoplankton accounted for 10-40% of the total phosphorus, while dissolved phosphorus was 35-75% and organic phosphorus 0-40% of the total. The steady state model was recommended for use as a management tool when detailed analyses are not practical. (Geiger-FRC) practical. (Geiger-FRC) W81-02139

EFFECT OF INDUSTRIAL POLLUTION ON THE KALU RIVER ECOSYSTEM,

Institute of Science. Bombay (India). Environmen-

tal Chemistry Lab.
G. N. Mhatre, S. B. Chaphekar, I. V. R. Rao, M.
R. Patil, and B. C. Haldar.

Environmental Pollution, Series A: Ecological and Biological, Vol 23, No 1, p 67-78, September, 1980, 2 Fig, 4 Tab, 19 Ref.

Descriptors: \*Water pollution effects, \*Industrial wastes, \*Aquatic life, Pollutants, Water quality, Kalu River, \*India.

In an effort to understand the effects of industrial in an enfort to understand the effects, of industrial effluents on estuarine ecosystems, water samples were taken from the Kalu River. This river originates in the Western Ghats, later reaching the Bhatsai River and then the Ulhas River near Kalyan, an industrial suburb of Bor. 1y. The combined river flows for about 45 km further, receiving effluents from more than 150 industrial units before it meets the Arabian Sea. The major differ-

#### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

#### **Group 5C—Effects Of Pollution**

ences between water quality at Ambivali and that at Titwala, 8 km upstream, were accounted for by the discharge of effluents from four industrial plants at Ambivali. Aquatic life was severely hindred at Ambivali. Aquatic life was severely hindred at Ambivali, with the water contaminated by both inorganic and organic pollutants including metals, chlorides, dyes, organic acids and others. Toxic heavy metals were studied in detail both in the water and in the sediments along the route. Sediments contained high levels of toxic metals at both Ambivali (which was expected) and Titwala to the Ambivali (which was expected) and Titwala (which was unexpected). The diversity of aquatic plants in the intertidal region at Ambivali was low compared with that at Titwala. Algae were abundant at Titwala, but hardly any were found at Ambivali. (Baker-FRC)

STEADY-STATE OSCILLATION OF UPTAKE KINETICS BY MICROORGANISMS IN MESO-TROPHIC AND EUTROPHIC WATERMASSES, Tsukuba Univ., Ibaraki (Japan). Inst. of Biological

Sciences.
H. Seki, T. Terada, and S. Ichimura.
Archiv fur Hydrobiologie, Vol 88, No 2, p 219-231, March, 1980. 4 Fig, 20 Tab, 12 Ref.

Descriptors: \*Kinetics, \*Eutrophication, \*Cycling nutrients, Amino acids, Carbohydrates, \*Japan, Nitrogen, Seasonal, Fluctuations, Municipal wastes, Environmental effects, Rivers, Temperature, Mesotrophy, Aquatic microorganisms, Bays.

Michaelis-Menton kinetics were used to measure the in situ amplitude of steady-state oscillations in the microorganisms of the Inohzawa River, Shimoda Bay and Kuroshio Counter Current. These three sites were affected directly or indirectly by municipal waste discharges of Shimoda City, Japan. Bioassays conducted during all four seasons showed that turnover rates of the amino acids and carbohydrates are divided without regard to seasonal changes by thresholds among a mesotrophic watermass of the Kuroshio Counter Current and a eutrophic watermass of Shimoda Bay. The kinetics of the Inohzawa River were classified as eutrophic. Turnover rates suggested that the steady-state oscillations occurred in a certain range divided by the thresholds. Evidence was also present which indicated regulation of the oscillations by inorganic nitrogen with a negative feed-back system similar to that found in vivo. Temperature had little effect on the steady-state oscillations of the area. (Geiger-FRC)

#### 5D. Waste Treatment Processes

FEASIBILITY OF ON-SITE DENITRIFICA-TION OF WASTE WATER BY SEPARATION OF GREY AND BLACKWATER,

Connecticut Univ., Storrs. Inst. of Water Resources.

R. Laak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173916, Price codes: A02 in paper copy, A01 in microfiche. Technology Transfer Report, 1981. 6 p. OWRT-A-999-CONN(19), 14-34-0001-0107.

Descriptors: \*Denitrification, \*Waste water, \*Nitrification, \*Waste water treatment, Greywater, Blackwater, Separation techniques, Filters.

A condominium complex with eight separate systems and a private residence were used to study the feasibility of on-site denitrification of waste water by separating grey and blackwater. The condominium complex denitrification reactors and groundwater quality could not be sampled due to leakages and temporary access difficulty. However, laboratory studies and the private residence verified that greywater is a suitable and feasible organic carbon source for the denitrification step. The most difficult step was found to be the nitrification filter design. Conventional subsurface underdrain filters need to be redesigned to yield optimal nitrification of the blackwater. The passive denitrification system called the RUCK system requires no more maintenance and operation than a

conventional septic tank system. The RUCK effluent far surpasses conventional septic tanks and package plan effluent quality.

COMBINED SEWER SYSTEM ANALYSIS USING STORM AND SWMM FOR THE CITY OF CORNWALL,

Gore and Storrie Ltd., Ottawa (Ontario).

J. C. Anderson.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-173858,
Price codes: A11 in paper copy, A01 in microfichel.
In: Proceedings, Stormwater Management Model (SWMM) Users Group Meeting, 19-20 June, 1980,
Toronto, Ontario, Environmental Protection
Agency Report EPA 600/9-80-064, December,
1980, p 1-22. 7 Fig, 4 Tab.

Descriptors: \*Combined sewers, \*Storm water, \*Model studies, \*Sewage disposal, Canada, Waste storage, Overflow, St. Lawrence River, Water pollution, Interceptor sewers, Treatment facilities, Hydraulics, \*Cornwall(Ontario).

In the City of Cornwall, Canada, the flow from combined sewers is intercepted through regulator chambers, designed to intercept 2.5 times dry-weather flow. All flows exceeding this amount are discharged directly to the St. Lawrence River. At present, the plant is operating in an overloaded condition, and high bacteria levels have been measured at swimming beaches along the river shore. The Storage Treatment Overflow Model (STORM) was used to screen a number of control alternatives, and develop statistics with respect to system operation for various levels of both storage and treatment capacities. Subsequently, the Storme Water Management Model (SWMM) was used to assess selected control alternatives under individual event operation. After the STORM model was calibrated and modified for local conditions, a simulation of the system operation was undertaken over a period of one year, comparing both volume of overflow and number of events to those actually measured. Control alternatives considered include: various levels of treatment plant capacity expansion in-system storage, diversion of storm flows from the combined sewer system, improvements in street sweeping practices and industrial flow control or abatement. The most promising alternative is some combination of storage and treatment. SWMM was used to assess the hydraulic operation of the interceptor sewer under individual event operation with the easterly overflows closed and the entire wet weather flow intercepted. (Moore-NEC)

THE APPLICATION OF E.E.C. BATHING WATER STANDARDS TO THE DESIGN OF SEA OUTFALLS,

Dundee Univ. (Scotland). Dept. of Civil Engineer-

J. A. Charlton

Progress in Water Technology, Vol 12, No 1, p 369-382, 1980. 6 Fig, 16 Ref, 1 Append.

Descriptors: \*Waste dilution, \*Dispersion, \*Outfall sewers, Ocean currents, Tidal effects, Waste water treatment, Tracers, E. coli, Mediterranean, United Kingdom.

Survey and outfall design methods which have been successful in high and low tidal activity areas surrounding the United Kingdom are described. The direct discharge of macerated and screened sewage through a carefully designed outfall can meet the current E.E.C. bathing water standards. Water movement in the area of a proposed outfall must be measured using current metering or float and drogue tracking. Radioactive tracers or fluorescent dyes can be used for dispersion studies. A long term analysis of the wind climate can aid in the assessment of bacterial levels within the effluent plume. The possibility of a thermocline and the problem of low tidal energy are considered if the area under study is in the Mediterranean. The method of discharge will be influenced by these factors. For example, it may be necessary to release the sewage at a level above the thermocline

so that effluent is not trapped below the surface where ultraviolet light cannot aid in reduction of bacteria (E. coli). (Small-FRC) W81.01958

MODELLING THE BIOCHEMICAL OXIDA-TION PROCESSES IN ARTIFICIAL CONDI-TIONS OF WASTE TREATMENT PLANTS,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.

V. A. Vavilin, V. B. Vasiliev, and S. S. Kuzmin. Ecological Modelling, Vol 10, No 2, p 105-137, July, 1980. 7 Fig. 7 Tab, 81 Ref.

Descriptors: \*Model studies, \*Waste water treatment, \*Oxidation, Mathematical models, Activated sludge, Monod's model, Grau's model, Ammonia, Glucose, Organic wastes.

Models for the biochemical oxidation of organic materials in waste water treatment plants are compared. Waste treatment models in activated sludge systems or biofilm reactors can be explained by either the diffusion mechanisms of oxidation of single substrates or by superimposition of the kinetics of oxidation of single substrates onto measurements of the dynamics of oxidation of a complex pollutant. In a multicomponent substrate thate of oxidation of sewage water depends on number, type, and concentration of the single substrate; characteristics of sludge and biofilm; and hydrodynamic characteristics of liquid flow. Grau's and Monod's models are similar, with one coefficient to be determined in Grau's model and two in both Grau's refined model and Monod's model. This paper derives the conditions under which zero- and first-order models are valid for oxidation of single substrates, and gives formulas for rate constants and a formula for the half-saturation constant. Experimental data on glucose and ammonia agreed satisfactorily with data calculated from the model. (Cassar-FRC)

DETERMINATION OF HYDROLYTIC ACTIVITIES IN WASTE WATER SYSTEMS BY MICROCALORIMETRY,

Innsbruck Univ. (Austria). Hygienisches Inst. B. Redl, and F. Tiefenbrunner. Water Research, Vol 15, No 1, p 87-90, January, 1981. 5 Fig. 14 Ref.

Descriptors: \*Biodegradation, \*Anaerobic digestion, \*Microcalorimetry, Kinetics, Sludge digestion, Metabolism, Carbohydrates, Proteins, Analyical techniques, Monitoring, Thermodynamic behavior, Testing procedures, Waste water treatment, Biological treatment, \*Waste water facilities.

A method is described for the evaluation of hydrolytic processes in waste water systems by isother-mal microcalorimetry. The adaptation of the degradation system to a particular substrate was measured in terms of net heat production. Samples examined included supernatant from the sludge drainage from a sludge densifier, a digested sludge taken from a digestion tank, a sludge taken from a digested sludge storage area, and water from the collecting basin of a garbage dump. Heat fluxes were recorded for the actions of samples on substrates of cellobiose, starch, skim milk, carboxymethylcellulose (CMC), and olive oil, and thermograms of heat effects over a 30-hour period were compared. Supernatant from sludge drainage was able to degrade all of the samples added to it within a 20 hour period. Cellobiose and starch were consumed much more slowly by the digested sludge samples from the sludge storage area, and CMC and olive oil were not hydrolyzed at all by this system within the observation period. In the basin water system, cellobiose was degraded more rapidly than CMC or starch. It was deemed possible to draw conclusions about the degree of degradation on the basis of the total amount of heat produced. The method permits direct and continuous monitoring of microbial activity and is particularly well adapted to anaerobic conditions. (Geiger-FRC)

#### VOLATILE ORGANIC ACIDS IN RAW WASTE WATER AND IN PHYSICO-CHEMICAL WATER AND TREATMENT,

Technion - Israel Inst. of Tech., Haifa. Environ-mental and Water Resources Engineering. N. Narkis, S. Henefeld-Fourrier, and M. Rebhun. Water Research, Vol 14, No 9, p 1215-1223, Sep-tember, 1980. 5 Fig. 7 Tab, 16 Ref.

Descriptors: \*Organic acids, \*Volatility, \*Waste water treatment, Sewage, Sewage treatment, Chemical precipitation, Chemical analysis, Chemical degradation, Flocculation, Activated carbon.

The composition of volatile acids in raw sewage and the content of each individual acid was studand the coment of each individual active was stud-ied. Haifa municipal sewage and fresh residential sewage from Neveh Shaanan were sampled. The age of the municipal sewage at the point of sam-pling is estimated to be 6-12 hr. The age of the residential waste water at the collection point is 10-00 min. The accounters of helytic sortly server. 60 min. The percentage of volatile acids was much higher at the municipal treatment plant than in the residential waste water. Experimentation proved that the concentrations of acetic, propionic, butter and the sovuleric acids increase on storage at room temperature and in a refrigerator. Smaller changes were also noted in butyric and isovaleric acids, while valeric acids remained constant. Hescale in the state of Extension measurements. anoic acid was not detected. Extensive anaerobic decomposition takes place in the Haifa region sewage due to longer flowing time. (Baker-FRC) W81-01990

# SEPARATION OF LINDANE FROM ITS AQUEOUS SOLUTIONS BY REVERSE OSMO-

SIS SYSTEM, Health and Welfare Canada, Ottawa (Ontario).

Health Protection Branch.
M. Malaiyandi, P. Blais, and V. S. Sastri.
Separation Science and Technology, Vol 15, No 7,
p 1483-1488, August, 1980. 2 Tab, 13 Ref.

Descriptors: \*Pesticides, \*Water purification, \*Reverse osmosis, Waste water treatment, Membrane processes, Potable water, \*Lindane, Water pollution, Osmosis, Water treatment.

Lindane at trace levels partially crossed a cellulose acetate reverse osmosis membrane. Another portion of the pesticide was adsorbed onto the mem-brane and slowly released into the product water. Since reverse osmosis water purifying systems are used extensively to produce high quality water for used extensively to produce night quantity water for electronics and medical use, the possibility of such water contamination should not be overlooked. After treatment, 36 and 24 + or - 1% of the initial quantities of lindane were found in recycled feed quantities of intaities were found in recyclect used and product solutions, respectively, leaving 40% unaccounted for and presumed adsorbed on the membrane. Repeated washing of the membrane with water and ethanol removed 10% of the total. Destructive testing of the membrane indicated that a major portion of lindane was tenaciously ad-sorbed. (Cassar-FRC) W81-01996

# VOLATILIZATION, PLANT UPTAKE AND MINERALIZATION OF NITROGEN IN SOILS TREATED WITH SEWAGE SLUDGE, Purdue Univ., Lafayette, IN. Water Resources Re-

Purdue Univ., Lafayette, IN. Water Resources Research Center.
L. E. Sommers, C. F. Parker, and G. J. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173940, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 133, February, 1981. 64 p, 23 Fig. 24 Tab., 74 Ref. OWRT B-084-IND(1).

Descriptors: \*Sludge utilization, \*Sewage sludge, \*Crop response, \*Sorghum, \*Ammonia volatilization, Sludge disposal, Land treatment, Water pollution, Ammonia, Nitrogen, Activated sludge, An-aerobic digestion, Nitrogen mineralization, Soil treatment, Application methods, Impaired water

Field and laboratory experiments were conducted to quantify the amount of ammonia volatilization taking place after application of sewage sludge to the soil surface, evaluate the movement of nitrogen

and plant uptake from soils treated with sewage sludge, and determine the potential N mineralization in a wide range of sewage sludges. Volatilization of NH sub 3-N was found to be dependent upon the method of sludge application, initial soil moisture content and sludge pH. Sorghum plants recovered 7 to 27% of the total sludge N while the recovery of the total N ranged from 8 to 33% considering the N in the soil to a depth of 90 cm. considering the via the sour to a depth of 90 cm.
Significant losses of sludge inorganic N occurred
within 3 days of application. The amount of mineralizable N in 24 sewage sludges was found to be
proportional to the total organic N content. The proportional to the total organic N content. The results of the study demonstrated the need to use a different N mineralization percentage for the various sludge types. Recognizing the limitation of the study, the recommended N mineralization percentage to use in calculating the appropriate sludge application rate for agronomic crops is 25% for raw and primary sludges, 40% for waste activated sludges, 15% for anaerobically digested sludges and 8% for composted sludges.

#### SLIMES CONSOLIDATION AT THE HENDER-

SON MINE, Bureau of Mines, Spokane, WA. Spokane Research Center.

R. H. Sprute, and D. J. Kelsh. Available from Supt. of Documents, GPO, Washington, DC 20402, No. 128. 23: 8441. Bureau of Mines Report of Investigations, 8441, 1980. 20 p, 9 Fig. 3 Tab. 5 Ref

Descriptors: \*Waste treatment, \*Mine wastes, \*Dewatering, \*Mine water, Colorado, \*Slime, Settling basins, Zeta potential, Electrophoresis, Elec-

Underground accumulations of slimes in the Henonderground accumulations of sinine in the Frei-derson molybdenum mine are routed to two large collection pits where they are dewatered and con-solidated by application of direct electrical current. Densified material is then removed to ore cars by rubber-tired front-end loaders and transported out of the mine. The electrical dewatering installation is described and its efficiency of operation com-pared with that predicted from preliminary studies performed by the Bureau of Mines. Direct current from a 150 kilowatt rectifier (applied for 44 hours from a 150 kilowatt rectifier (applied for 44 hours at 400 amperes and 65 to 70 volts) converted slimes containing 25.3% solids to material ranging from 44 to 65% solids. Better results can be expected if the ramp and front sections of the pits are treated separately, using higher current density. The sump design and mode of operation should be generally applicable to other underground metal mines, following preliminary laboratory tests. (Brambley-SRC) W81-02014

#### EFFLUENT CAN BE EXPENSIVE. Imiesa (Johannesburg), Vol 4, No 5, p 9, 57, May, 1979. 1 Fig.

Descriptors: \*United Kingdom, \*Water pollution, \*Effluents, \*Water reuse, Recycling, \*Waste water treatment, Industrial wastes, Pollution abatement, Water authorities, Flocculation, Spillage, Oil wastes, Water costs.

A United Kingdom company, West Midlands Passenger Transport Executive, has installed a water recycling system to treat its effluent from the washing of engines, refuse disposal vehicles, and buses. The company was prompted to do this due to the increasing costs of effluent treatment by water authorities. The recycling system is marketed by Concept Cleaning Equipment and, since its installation, has solved the company's discharge problem and reduced the volume of clean water. problem and reduced the volume of clean water needed. Before entering the main recycling plant the effluent goes through a screen. Next it is treat-ed by electrolysis to separate the solids into floces. An upward flow of water causes most of the floces to settle to the bottom. After skimming the water flows through nylon bags and a carbon filter. Final recycled water has a pH of 7 with suspended solids of 6.5 ppm. The system requires careful operation and maintenance to keep water quality high. (Seigler-IPA)

W81\_02045

# SOLID LIQUID SEPARATION BY FILTRA-TION -- A REVIEW.

The Professional Engineer (Pretoria), Vol 7, No 2, p 9-10, April, 1978. 1 Fig.

Descriptors: \*Filtration, \*Separation techniques, \*Water purification, \*Filters, Centrifugation, Water quality, Sands, Rapid gravity filters, Liq-uids, Suspended solids, \*Water treatment, Re-

Filtration, the production of a clear liquid or of the particles suspended in the liquid, has many industrial process applications, however, the largest ap-plication is for water purification. Deep sand bed plication is for water purification. Deep sand bed illtration of water has been substantially devel-oped. More recent developments have been made with rapid gravity filters, where filter cleansing is particularly important. Although many accessories exist for rapid gravity filters, it is quite feasible to filter water effectively without them. Suspended solids clarifiers are considered an essential precur-ce to filtration. Clarification and rapid gravity. sonto charmers are considered an essential precur-sor to filtration. Clarification and rapid gravity filtration now form the basis for water purification. A wide variety of filters exist for the filtration of industrial liquids such as beverages, oils, ores, minerals, and pharmaceuticals. The plate and frame filter is generally used for beverage filtration. Vertical tank, horizontal leaf filters are also used for beverage filtration and for food polishing. Other industrial filtration methods include candle filters, vacuum filters, centrifuges, and ion exchange sepa-ration. (Seigler-IPA) W81-02048

# URBAN WASTE WATER POLLUTION CONTROL IN SOUTH AFRICA,

Johannesburg City Engineer's Dept. (South Africa) E. J. Hall.

Imiesa (Johannesburg), Vol 4, No 6, p 44-45, June.

Descriptors: \*South Africa, \*Waste water (Pollution), \*Urban hydrology, Waste water disposal, Eutrophication, Sludge treatment, Water quality standards, Water quality, \*Waste water treatment, Industrial water, Urban drainage, Solid wastes, Research and development, Water Act No.

A semi-arid climate with cyclic drought patterns has forced South Africa to emphasize high stand-ards of waste water purification to safeguard river water quality. As evidence of this emphasis, Johannesburg installed its first major sewerage system in 1904, and constant improvements have been made since then. In 1956 the Water Act No. 54 was enacted and superseded all earlier legislation. It enshrined the country's water resources as a na-tional asset to be under the control of the Department of Water Affairs. While the Act sets standards, no financial grants or subsidies are made and each local authority must bear the full costs of compliance with the Act. This policy has made industries water-conscious and has encouraged re-cycling. Active research at all levels is an impor-tant feature of waste water control. The South African Council for Scientific and Industrial Research and the National Institute for Water Re-search coordinate these activities. Current areas of search coordinate these activities. Cultrent areas of concern include eutrophication, sludge treatment, and solid waste disposal. South Africa can claim that it has not been backward in progress made with its major, but limiting resource, water. (Seigler-IPA) W81-02059

#### DESIGN OF DECHLORINATION UNITS FOR POWER PLANT COOLING STREAMS,

California Univ., Davis. Dept. of Chemical Engineering

C. Tan. S. Whitaker, and A. Berker.

Journal of the Water Pollution Control Federation, Vol 52, No 2, p 299-309, February, 1980. 11 Fig. 11

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### **Group 5D—Waste Treatment Processes**

Descriptors: \*Waste water treatment, \*Electric power industry, \*Cooling water, \*Chlorination, Turbulent flow, Utilities, Pollutants, Chemical reactions, Chemical engineering, Water pollution control, Water treatment, Effluents, Industrial wastes, Biocides, \*Dechlorination, Model studies.

A simplified model for solving the turbulent diffu-A simplified model for solving the turbulent diffu-sion equation for multiple injection points is pre-sented to aid in design of dechlorination units for once-through power plant cooling streams. In these systems sulfurous acid is reacted with the hypochlorous acid formed from the biocidal chlor-ination process to form year, dilust hydrochloriination process to form very dilute hydrochloric and sulfuric acids, which are discharged into a nearby river. Since the available reaction time is often less than a minute, mixing and chemical reaction rates are important. Thus smaller, multiple rijection points have advantages over a larger single point. This equation relates the available length of the mixing channel to the number of injection points and the dose of sulfurous acid. In most cases a calculated overdose of sulfurous acid produces the best results. (Cassar-FRC) W81-02084

LEAD REMOVAL WITH ADSORBING COL-LOID FLOTATION, Vanderbilt Univ., Nashville, TN. E. L. Thackston, D. J. Wilson, J. S. Hanson, and

E. L. Trackston, D. J. Wilson, J. S. Hanson, and D. L. Miller, Jr. Journal of the Water Pollution Control Federation, Vol 52, No 2, p 317-328, February, 1980. 3 Fig, 3 Tab, 47 Ref.

Descriptors: \*Lead, \*Flotation, \*Froth flotation, Heavy metals, Metals, Waste treatment, \*Waste water treatment, Industrial wastes, Pilot plants, Flocculation.

Lead was removed from waste water in batch and continuous-flow studies of a flotation process. Batch experiments (lead concentration 50 mg per liter) showed that the optimum pH was 6.5, and that increasing ionic strength was detrimental. Above 4,250 mg per liter sodium nitrate, the separation efficiency dropped off noticeably. Ferric hydroxide proved to be a more effective adsorbing floc than aluminum hydroxide. Sodium hydroxide was a batch grant for the solid provide to the solid provide the solid provide solid provides the solid provides was a better neutralizing agent than sodium car-bonate. Pilot plant studies using a flotation column 30 cm in diameter and 244 cm long were successfully conducted with a synthetic waste water confully conducted with a synthetic waste water containing lead at 20 mg per liter. pH control was the most acute operating problem. A 0.25 molar sodium hydroxide solution proved to be the optimum neutralizing agent. Optimum operating parameters for the 30-cm column were as follows: pH, 6.0-7.0; ferric hydroxide concentration, 100-150; sodium lauryl sulfate detergent, 35-40 mg per liter; hydraulic loading rate, 150-180 cu meters per ometer per day and in flow 24-30 cu meters per operations. sq meter per day; and air flow, 24-30 cu meters per sq meter per hour. If the effluent contained a high concentration of ions, a pH lower than 6.0 was more efficient. Field testing on waste water containing zinc, copper, and a variety of other materials produced interferences from phosphates and silicates. Subsequent refinements of the process produced effluents with 0.05 mg lead per liter at costs amounting to 50% of those of the traditional lime precipitation method. (Cassar-FRC) W81-02085

MINIMIZING SLUDGE HANDLING AND ENERGY REQUIREMENTS FOR ADVANCED WASTE WATER TREATMENT,

Turnipseed (G. Ben), Inc., Atlanta, GA. G. B. Turnipseed, R. P. Rivinus, and J. Brown. Journal of the Water Pollution Control Federation, Vol 52, No 2, p 364-371, February, 1980. 7 Fig, 4

Descriptors: \*Sludge treatment, \*Sludge disposal, Waste water treatment, "Ultimate disposal, Engineers estimates, Planning, Water pollution control, Disposal, Methane, Pilot plants, Fertilizers, Nitrification, Biological oxygen demand, Estimated costs, Energy conservation, \*Cobb County(GA),

Several alternatives for sludge treatment at the proposed Noonday Creek Water Pollution Control

Plant, Cobb County, Georgia, were considered in response to increasing sewerage needs and more stringent effluent requirements. Particular attention was given to minimizing sludge handling and energy costs. The rotating bio-disk system was chosen for the wet-treatment process. The system for solids treatment and disposal included thickening, digesting, dewatering, and heat drying/pelletization with subsequent sale as a fertilizer-soil conzation with subsequent sale as a terrilizer-soil con-ditioner. Pilot plant studies for the proposed plant indicated final design hydraulic loading rates of 1.1 gal per day per sq foot. 70% suspended solids and 30% influent BOD will be removed by primary 30% influent BOD will be removed by primary clarification. Aluminum sulfate was the most effective chemical precipitating agent. Chemical costs for alkalinity adjustment during nitrification were estimated at 5765 per day for sodium aluminate/alum and \$645 per day for alum only. Methane gas from sludge digestion will be used to supply building heat and sludge heat, producing an annual energy savings of \$32,000. Total annual sludge head line acceptance activated at \$120 per tou lege energy savings of 352,000. Total annual sludge handling costs were estimated at \$120 per ton, less \$27 per ton income from selling the fertilizer prod-uct. Construction costs will be about \$16 million. (Cassar-FRC)

PREDICTION OF ALKALINITY CHANGES IN

THE ACTIVATED SLUDGE PROCESS, Virginia State Dept. of Health, Danville. S. N. Scearce, R. W. Benninger, A. S. Weber, and J. H. Sherrard.

Journal of the Water Pollution Control Federation, Vol 52, No 2, p 399-405, February, 1980. 5 Fig, 6 Tab, 12 Ref.

Descriptors: \*Activated sludge, \*Waste water treatment, \*Nitrogen compounds, \*Alkalinity, Nitrification, Nitrates, Ammonium compounds, Hydrogen ion concentration.

Nitrification causes a pH drop during activated sludge waste water treatment, requiring constant addition of alkalinity to maintain optimum conditions. Differences between the theoretical (7.14 mg per liter as CaCO3) and observed values of alkalinites. ity destroyed per unit nitrate formed prevent accurate pH adjustments. Therefore, the authors pro-pose a formula based on the theory that mineralizapose a formula based on the theory that mineraliza-tion of organic nitrogen can impart alkalinity to waste water: Change in alkalinity = 3.57 (Change in filtrate organic nitrogen - Synthesized nitrogen) -7.14 (Change in nitrate nitrogen). At high ratios of COD to total Kjeldahl nitrogen (TKN) the microbial biomass uses a large proportion of TKN, leaving little available for nitrification and causing little destruction of alkalinity. Conversely, low COD:TKN ratios cause a large pH drop. As the TKN:ammonium nitrogen ratio increases, greater amounts of organic nitrogen become available, and greater alkalinity reduction can take place. (Cassar-FRC) FRC) W81-02089

DIGITAL ON-LINE CLOSED-LOOP CONTROL FOR WASTE WATER TREATMENT OPER-ATION,

Metropolitan Denver Sewage Disposal District No. 1, CO. J. K. Nelson, and B. B. Mishra.

Journal of the Water Pollution Control Federation, Vol 52, No 2, p 406-415, February, 1980. 6 Fig.

Descriptors: \*Computers, \*Sewage treatment, Descriptors: Computers, Sewage treatment, Spligital computers, "Automatic control, "Waste water treatment, Data processing, Data storage and retrieval, Control, "Denver, Colorado, Remote control, Instrumentation, Sludge, Man-

Actual operating experiences using a direct digital control system at the Metropolitan Denver Sewage Disposal District No. 1 are described. A dual, redundant, computer-based data acquisition and control system with remote input/output multiplexing is used for monitoring and direct digital control. There are 160 analog inputs, 46 analog control outputs, 4 analog display outfits, 550 discrete inputs, and 35 control outputs. Since January, 1977, the system has been successful in controlling influent flow split, primary sludge pumping, sec-

ondary influent pumping, return sludge flow, waste activated sludge control, digester feeding, and process quality parameter monitoring. This facility includes a 42 mgd primary treatment process and a 72 mgd high purity oxygen activated sludge process. Although only 10 persons are needed to properly operate the equipment, they are highly trained and paid, offsetting the savings from a reduction in the manpower previously needed. However, the system demonstrates efficiency, valid data collection and reporting, true ciency, valid data collection and reporting, true real time process control, experimentation with advanced control techniques, and centralized control. (Cassar-FRC) W81-02090

FILTERBELT PRESSING OF SLUDGE--A LAB-ORATORY SIMULATION,

Chalmers Univ. of Technology, Goeteborg (Sweden) R. E. Halde

Journal of the Water Pollution Control Federation, Vol 52, No 2, p 310-316, February, 1980. 9 Fig, 1 Tab, 6 Ref.

Descriptors: \*Sludge treatment, \*Filtration, \*Waste water treatment, Dewatering, Filterbelt presses, Model studies, Laboratory equipment, Testing, Separation techniques.

A flexible laboratory piston press detected small differences in sludge dewaterability. Many variations of filterbelt pressings may be simulated by subjecting the sludge to repeated pressings at varied time and pressures according to the process being studied. In this experiment only double nips were investigated (25 sec, 65 sec; 45 sec each; and 65 sec, 25 sec) at combinations of pressures from 50 to 500 Lp. Dependent process of the pressure from 50 to 500 Lp. Dependent process of the pressure from 50 to 500 Lp. Dependent process of the pr to 500 kPa. Best dewatering was obtained when the second nip was at least as long as the first. This the second mp was at least as long as the Irrst. I his press was also used to determine the effects of various conditioning operations on sludge dewaterability. Aluminum sulfate-treated sludge produced a cake containing 8% dry solids; ferric chloride, 8.5%; polelectrolyte, 11%; and lime, 23%. Conditions used were a sludge load of 1.3 kg dry solids per sq meter; pressure 100 kPa; time, 85 sec; and precific time of pressure increase, 0.15 sec per kPa. per sq meter; pressure 100 kPa; time, 85 sec; and specific time of pressure increase, 0.15 sec per kPa. No shear was applied. (Cassar-FRC) W81-02093

TRACE METALS AND ANAEROBIC DIGES-TION OF LEACHATE,

Pritish Columbia Univ., Vancouver.
R. D. Cameron, and F. A. Koch.
Journal of the Water Pollution Control Federation,
Vol 52, No 2, p 282-292, February, 1980. 4 Fig. 10
Tab, 13 Ref.

Descriptors: \*Metals, \*Leachate, \*Anaerobic digestion, Trace elements, \*Landfills, Waste treatment, Biological treatment, Waste disposal, Biodegradation, Digestion, Aluminum, Barium, Cadmium, Mercury, Nickel, Zinc, Iron, Chromium, Copper, Lead, Manganese, Calcium, Magnesium, Potassium, Sodium, Heavy metals removal.

Leachate from landfills was anaerobically digested at 29 to 38C to determine the effect of trace heavy metals on the process and to assess heavy metal removal. In a medium-strength leachate 81 of BOD was removed. Settled effluent BOD removal was 83, 91, and 97% for solids detention times of 5, 10, and 20 days, respectively. COD removal varied from 65 to 80%. Heavy metals did not affect the digestion process, even over a long term operation with high loading and short retention time. Metal process are some contractions are considered to the contraction of the co term operation with high loading and short reten-tion times. Metal removal efficiencies were greater than 85% for Al. Ba, Cd, Hg, Ni, and Zn; 80% for iron; 40-70% for Cr, Cu, Pb, and Mn; 30% for Ca; and less than 10% for Mg, K, and Na. Most of the metals were associated with the sludge solids, most likely as insoluble precipitates or organically-bound complexes. There are several advantages to using this process to biostabilize landful leachates— low heat requirements, successful performance. using inits process to distantize faintini leachates. low heat requirements, successful performance, and ability to handle high-strength leachates. Before returning the sludge to a landfill, it is im-portant to determine the exact form of the metal

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Waste Treatment Processes—Group 5D

contaminants so they will not be rapidly released upon acidification. (Cassar-FRC) W81-02094

# WATER QUALITY CONVERSION MATRIX OF AEROBIC BIOLOGICAL PROCESSES,

Hokkaido Univ., Sapporo (Japan). N. Tambo, and T. Kamei.

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 1019-1028, May, 1980. 8 Fig. 6 Tab. 6 Ref.

Descriptors: Water quality, \*Aerobic treatment, \*Organic compounds, \*Biological treatment, Activated sludge, \*Waste water treatment, Water prurification, Trickling filters, Industrial wastes, Chromatography, Sewage treatment, Biological oxygen demand, Chemical oxygen demand, Efficiencies.

A conversion matrix was designed to determine water quality in evaluation of aerobic biological water and waste water treatment processes such as the activated sludge process, self-purification of natural water, and biological slow sand filtration. Organic compounds under consideration were di-Organic compounds under consideration were di-vided into 6 groups by gel chromatography, and the dissolved organic carbon was measured at 260 nm. The derived removal efficiencies were ar-ranged in a 2 dimensional matrix with respect to group number, and the extent of removal from various samples was estimated. Fairly good agree-ment between predicted and observed values was obtained for a variety of waste waters and for acetic acid solution. Slow and filtration of diluted obtained for a variety of waste waters and for acetic acid solution. Slow sand filtration of diluted raw waste water and secondary effluent had higher experimental values than predicted because of in-teraction with ammonia and organics in the filter. (Cassar-FRC) W81-02096

#### OXYGEN UPTAKE AS A CONTROL PARAM-

ETER, Memphis State Univ., TN. Dept. of Civil Engi-

neering.
H. A. Khararjian.
Journal of the Water Pollution Control Federation,

Vol 52, No 4, p 823-824, April, 1980. 1 Fig, 1 Tab,

Descriptors: \*Oxygen requirements, \*Activated sludge, \*Control, Microorganisms, ? Equations, Design, \*Sanitary engineering.

The use of oxygen uptake rates to control the activated sludge process is discussed. Energy and endogenous oxygen uptake was determined from batch experimental data, and as loading increased, endogenous oxygen demand increased and energy endogenous oxygen demand increased and energy oxygen demand decreased. These trends can be attributed to the ability of the microorganisms to store food and utilize it whenever the exogenous source of food is depleted. The variation in oxygen uptake is a function of the utilization rate or food to microorganism ratio, which is controlled by the influent organic content and the mixed liquor sus-pended solids in the aeration basin. The Eckenfelder equation can be used to plot oxygen uptake The use of this equation, the coefficients of which are not constants, in the control of activated sludge may not be warranted when the influent is variable and heterogeneous. It may cause further complication of control strategies. It may, however, be useful in the design stages. (Small-FRC) W81-02098

# DESIGN AND PERFORMANCE OF NIGHT

DESIGN AND PERFORMANCE OF NAME OF SOIL TREATMENT PLANTS, Institute of Public Health, Tokyo (Japan). Y. Magara, D. Sugito, and K. Yagome. Journal of the Water Pollution Control Federation, Vol 52, No 5, p 914-922, May, 1980. 4 Fig. 5 Tab.

Descriptors: \*Sewage treatment, \*Standards, Tertiary treatment, Anaerobic digestion, \*Treatment facilities, Design, Domestic wastes, \*Japan, Night

In Japan, 89,959 kl/day of night soil is collected by m trucks from offices and homes and treated

at 1186 night soil treatment plants. Septic tanks are at 1186 night soil treatment plants. Septic tanks are unusual in Japan, and public sewerage does not yet reach all of the population. Before a night soil treatment plant is built, the local government is required to prepare a basic plant construction program based on a per capita excretion of 1.4 liters of human waste per day. The monthly average BOD of the effluent must be lower than 30 mg/liter, suspended solids must be less than 70 mg/liter, and the celifers besilf; court must be lower than suspended solids must be less than 70 mg/ nter, and the coliform bacilli count must be lower than 3000/ml. The central government specifies design criteria for treatment processes capable of meeting these standards. Most existing plants use anaerobic tness standards. Most existing plants use anacronic and aerobic digestion activated sludge processes. Advanced treatment processes are often necessary to meet present standards. These include direct incineration, high organic loading activated sludge, biological denitrification, and an exclusive treat-ment process for collected sludge from night soil purification tanks. Good night soil treatment eliminates the use of conduits and conserves water nates the use of conduits and conserves water, since flush toilets are not needed. Collected night soil treatment can add much to public health with-out significant costs. (Small-FRC) W81-02099

## MATHEMATICAL MODEL FOR IMPROVING COMBINED SEWER SYSTEMS,

Public Works Research Inst., Ibaraki (Japan). For primary bibliographic entry see Field 4A. W81-02104

# ODOR CONTROL OF WASTE WATER TREAT-

MENT PLANTS, Japan Sewage Works Agency, Tokyo. Ando

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 906-913, May, 1980. 2 Fig, 5 Tab.

Descriptors: \*Odor, \*Aeration, \*Waste water treatment, Treatment facilities, Control, Pollution abatement, Japan,

Odor in Japan is regulated by the Offensive Odor Control Law, which provides for municipal ordin-ances against odor discharge. Out of 288 munici-palities that have waste water treatment plants, 161 palities that have waste water treatment piants, 101 (71%) are regulated. Most waste water plants are covered completely or partially with a roof, which helps control odors. There are 129 deodorizing facilities which employ water scrubbing, activated carbon adsorption, ozonation, or acid scrubbing. Several examples are given of deodorizing facilities. At the Toyohiragawa plant in Sapporo City part of the odorous material is incinerated at high temperatures, and another portion is used as air in an aeration tank. At the Fukashiba plant odor from the grit chamber and pumping room is treated by activated carbon adsorption. Research is being conducted on methods of odor control, and new treatment methods are being investigated to con-trol odor production. More than half of the complaints about plant odors are caused by aeration tanks of the diffuser type. Mechanical aeration or a pure oxygen process are possible alternatives. (Small-FRC) W81-02105

#### WASTE WATER TREATMENT PLANTS AND POLICIES OF KYOTO.

Japan Sewerage Bureau, Kyoto

Yoneda Journal of the Water Pollution Control Federation, Vol 52, No 5, p 978-984, May, 1980. 4 Fig, 4 Tab.

Descriptors: \*Kyoto(Japan), \*Sewerage, \*Waste water treatment, Municipal wastes, Oxygenation, Activated sludge, Sludge disposal, Effluents, Water pollution, Japan.

The city of Kyoto, Japan, population 1.5 million, The city of Kyoto, Japan, population 1.5 million, began construction of sewer facilities in 1930, suspended building during and after World War II, and by 1978 served 52% of its residents. Presently 3 treatment plants operate, discharging effluents into the Yodo River, which is a drinking water source for Osaka and Kobe. The Kisshoin plant started using a 20,000 cu meter per day oxygen system in September, 1977. This system is still undergoing evaluation and optimization. Sludge disposal is a problem for all the city's plants. Since 1973 sludge has been incinerated. Effluent quality is regulated by city ordinance, which is more strin-gent than national standards and requires pretreatgent than national standards and requires prefreat-ment of discharges containing toxic metals. Pro-gressive surcharges are imposed for waste water with BOD over 200 mg per liter. Present priorities include extension of the sewer system to a goal of 100% coverage. (Cassar-FRC)

# DEVELOPMENT OF SEWER SYSTEMS AND TREATMENT PLANTS IN TOKYO,

Tokyo Metropolitan Government (Japan). K. Terada.

Journal of the Water Pollution Control Federation. Vol 52, No 5, p 961-968, May, 1980. 2 Fig. 4 Tab.

Descriptors: \*Tokyo, Japan, \*Sewerage, \*Waste water treatment, Aeration, Activated sludge. Sludge disposal, Water reuse, Tertiary treatment. Municipal wastes.

The history, status, and present problems of Tokyo's sewer system are described. The system, started in 1883, serves 70% of the 8.5 million population and a large industrial complex. The inner city is served by 8 waste water treatment plants, using the activated sludge treatment process, with a total capacity of 5,453,000 cu meters cally. Sludge, presently produced at the city of cally. Sludge, presently produced at the city of cas, with a total capacity of 3,493,000 cu interest daily. Sludge, presently produced at the rate of 3,400 metric tons per year, was formerly dumped into Tokyo Bay and is now incinerated or used for land reclamation with and without mixing with cement. Present and future concerns are sludge disposal, public relations, reuse of effluent by in-dustry and for cleaning, overload of the combined system during periods of high rainfall, implementation of deep aeration tanks, and tertiary treatment. (Cassar-FRC) W81-02107

#### NAGOYA SEWERAGE PLAN.

Nagoya Municipal Government Dept. of Sewage Works (Japan). M. Ozeki.

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 969-977, May, 1980. 6 Fig. 3 Tab.

Descriptors: \*Sewerage, \*Nagoya(Japan). \*Waste water treatment, \*Municipal wastes, Activated sludge, Sludge disposal, Aeration, Japan.

The City of Nagoya, Japan, population 2.08 million, began sewerage planning in 1893. The old city area was equipped with pipes by 1923. Between 1930 and 1934 treatment plants were put into operation using activated sludge with diffused aeration. World War II destroyed much of the aeration. World War II destroyed much of the existing facilities, and recovery was not complete until 1953. Since this time, existing plants were improved and expanded, and additional ones were built. A new method of thickening, dewatering, and incinerating raw sludge was implemented, replacing the sandbed disposal method. Future plans include centralized sludge treatment and improvement of the quality of recycled wastes from sludge handling. Ocean dumping of sludge will increase as the quantity increases. Pollution and sewer overflow occurring during heavy rainfall will be remeflow occurring during heavy rainfall will be reme-died. (Cassar-FRC) W81-02108

#### CONTROL OF INDUSTRIAL WASTE WATER IN OSAKA,

Japan Sewage Works Bureau, Osaka. K. Nanbo.

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 992-998, May, 1980. 2 Fig. 5 Tab.

Descriptors: \*Industrial wastes, \*Water pollution control, \*Waste water treatment, Osaka, \*Japan. Water quality control, Control, Regulation. Discharge(Water), Legal aspects.

This paper describes the industrial waste water situation in Osaka, Japan. Of the city's 33,839 factories, 94.5% have less than 30 employees. The total industrial waste water sewer input for 1978

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### **Group 5D—Waste Treatment Processes**

was 339,801 cu meters per day. Regulations dictate that all waste water in a sewered area must be taken into the system unless otherwise designated. Certain specified factories may not discharge waste water into the sewer system unless it conforms water into the sewer system unless it conforms with specified requirements. Some industries may be obliged to construct their own treatment facilities. Spot inspections by patrol groups are made at the rate of 2.1 inspections per year for each factory using pretreatment. The violation rate was 24.2%. The police also investigate compliance, and violators are regularly prosecuted. Future concerns are a study of colored waste waters, limiting COD to a reasonable level, a study of recycling and reuse technology, establishment of guidelines for safe sludge disposal, and continuous, automatic water analysis. (Cassar-FRC)

# TANNERY WASTE WATER TREATMENT BY THE OXYGEN ACTIVATED SLUDGE PROC-

Japan Sewage Works Agency, Tokyo. M. Kashiwaya, and K. Yoshimoto. Journal of the Water Pollution Control Federation, Vol 52, No 5, p 999-1007, May, 1980. 1 Fig, 7 Tab.

Descriptors: \*Design criteria, \*Industrial wastes, Activated sludge, Oxygenation, \*Tannery wastes, Pilot plants, Himeji, \*Japan, Municipal wastes, \*Waste water treatment.

Pilot plant studies testing the oxygen activated sludge process to treat tannery waste water de-fined the design criteria and operation conditions to reduce BOD5 to 20 mg per liter or less. Deten-tion time at temperatures below 10C was reduced from 25 hours to 12 hours by combining the tan-Two percent plants have been built, in Himeji, Japan, one for 234 tanneries in the Takagi District and one for 99 in Shigo. All treated effluent will be further treated at the Tobu Waste will be further treated at the Tobu Waste Water Treatment Plant. Since tanneries are closed for holidays during several 10-day periods each year, a flow equalizer basin will be installed in the treatment plants. (Cassar-FRC)

# CURRENT RESEARCH ON ADVANCED WASTE WATER TREATMENT IN JAPAN,

Japan Sewage Works Agency, Tokyo. M. Kashiwaya, and T. Annaka. Journal of the Water Pollution Control Federation, Vol 52, No 5, p 1008-1012, May, 1980.

Descriptors: \*Waste water treatment, \*Japan, \*Re-search and development, \*Pilot plants, Technology, Activated sludge, Eutrophication, Phosphorus compounds, Nitrogen compounds, Filtration, Organic matter, Nitrification, Conservation.

In Japan, 84 educational and research institutions were involved in sanitary engineering research as of 1978. Of the 576 projects performed, 254 concerned waste water treatment. Private industry also contributed many technical papers on waste water treatment. Some subjects under consideration are removal of organic matter in secondary effluents, removal and control of phosphorus and nitrogen, waste water reuse, sludge disposal with recovery of Al and P, improvement of biological processes and minimum use of chemicals, ultimate sludge disposal, combined sewer overflow control, watershed management, and trace toxicant control. Currently, the Public Works Research Institute of the Ministry of Construction is operating 3 pilot plants to study a variety of waste water treatmen developments: phosphorus removal by chemical precipitation, ammonia removal by air stripping, on-site monitoring, and direct filtration of second-ary effluent with inert dual media filters. The Japan Sewage Works Agency operates laboratory and pilot studies concerning oxygen activated sludge, rotating biological contactors, ultra-high studge, rotating official contactors, untraction rate chemical coagulation, and improvement of eutrophic Lake Biwa. Future research should be directed toward conservation of energy, resources, directed toward conservation and land use. (Cassar-FRC) W81-02112

DISINFECTION OF SECONDARY TREATED EFFLUENT WITH OZONE. (DISINFECTION DES EAUX RESIDUAIRES URBAINES PAR L'OZONE.), SETUDE, Paris (France).

C. Gomella.
Progress in Water Technology, Vol 12, No 1, p 383-391, 1980. 1 Fig.

Descriptors: \*Chlorination, \*Ozonation, \*Sewage treatment, Methodology, Coliforms, Disinfection,

The disinfection of secondary treated effluent by chlorination and ozonation were compared. Filtered and unfiltered secondary effluent was disinfected by an economical method of ozonation. In the first stage of ozonation, a predetermined resid-ual of ozone is obtained. In the second state, the required ozone residual is maintained for a re-quired contact time. A four-fold reduction in total coliforms was obtained for non-filtered effluent by treatment with 8 g of ozone per cubic meter for a contact time of 9 minutes. For filtered effluent, the required dosage was 5 g of ozone per cubic meter for the same contact time. The same reduction in coliforms was obtained after chlorination of noncontorms was obtained arter cniorination of non-filtered effluent with 14 g/cu m for 13 minutes and filtered effluent with 10 g/cu m for 13 minutes and Ozonation improved the appearance, color, BOD, and COD, and had a slightly greater sterilizing effect on E. coli, fecal coliforms, streptococci, and salmonella than did chlorination. (Small-FRC) W81-02116

# STOCHASTIC APPROACH TO W. TREATMENT PLANNING, Utah Water Research Lab., Logan. For primary bibliographic entry see Field 6A. W81-02122 WASTE

PREDICTION OF THE CONTAMINATION PRODUCED BY DISPERSION OF EFFLUENTS THROUGH OCEAN OUTFALLS. (PREDIC-CION DE LOS NIVELES DE CONTAMINA-CION PRODUCIDOS POR VERTIDOS REALI-ZADOS A TRAVES DE EMISARIOS SUBMAR-

Ministerio de Obras Publicas, Madrid (Spain). Gabinete de Aplicaciones Nucleares.

For primary bibliographic entry see Field 5B. W81-02129

#### ADVANCED WASTE WATER TREATMENT REMOVES NUTRIENTS WITHOUT CHEMI-CALS

P. J. Leslie. Water and Pollution Control, Vol 118, No 10, p 12-13, 27, 30, October, 1980.

Descriptors: \*Nutrient removal, \*Tertiary treatment, \*Waste water treatment, Biological treatment, Phosphorus, Nitrogen, Sludge, Water quality, Water reuse, Nitrification, Denitrification, South Africa, Pilot plants, Temperature, Economius Production ics, Bardenpho proc

Work performed on biological nitrification/denitrification systems at waste water pilot treatment plants in South Africa has resulted in the develop-ment of a process (the Bardenpho process) for combined phosphorus and mirogen removal with-out the use of chemical additions. The Bardenpho process has been adopted by many waste water treatment plants in Africa, South America and the United States. The method is economically advantageous over techniques requiring chemicals, while providing more than 90% removal of nitrogen and phosphorus under anoxic conditions. In the Bardenpho process the waste water passes through a primary and a secondary anoxic zone before un-dergoing reaeration and forced anaerobic fermentation. Sludges contain no added metal salts and may be applied to land as fertilizers. The effects of low temperatures on the Bardenpho process were examined in Canadian pilot plant studies, with results which indicated that this biological treatment could survive the cold Canadian winters. The ad-aptations of the process to water reuse programs are also considered. (Geiger-FRC)

W81-02132

# MODELING AND PREDICTION OF SPECIFIC COMPOUND ADSORPTION BY ACTIVATED CARBON AND SYNTHETIC ADSORBENTS, National Inst. for Water Research, Pretoria (South

B. M. van Vliet, W. J. Weber, Jr., and H. Hozumi. Water Research, Vol 14, No 12, p 1719-1728, December, 1980. 6 Fig, 4 Tab, 19 Ref.

Descriptors: \*Adsorption, \*Activated carbon, \*Mathematical models, Kinetics, Waste water treatment, Phenols, Organic wastes, Terilary treatment, Water purification, Water treatment, Separation techniques, \*Synthetic adsorbents.

Eight synthetic adsorbents and two commercially available activated carbons were examined for their ability to adsorb phenol as a model for removal of specific organics from waste water. Both the adsorption equilibrium or capacity and the mass transport kinetics of the organic in each adsorbent were considered. Data derived from finitebatch, batch-reactor equilibrium and kinetic studies was incorporated into the numeric-based predicwas incorporated into the numeric-based predictive model for fixed-bed adsorber design. Independent experimental parameters obtained from fixed-bed adsorber runs were used to test the validity of model results. All of the isotherm data generated was mathematically described by a new empirical isotherm equation. Good agreement was achieved between the predicted and experimental breakthrough curves for the synthetic adsorbents, but for the two activated carbons, the two values agreed only about halfway through the curves. agreed only about halfway through the curves, followed by a slower approach to equilibrium. Possible reasons for this latter effect, which was not explained by the present model, are discussed. The model is considered satisfactory for applica-tion to water and waste water treatment systems. (Geiger-FRC) W81-02136

#### INACTIVATION OF F2 VIRUS WITH FER-RATE (VI).

Miami Univ., Coral Gables, FL. Dept. of Civil Engineering.
T. Schink, and T. D. Waite.

Water Research, Vol 14, No 12, p 1705-1717, December, 1980. 13 Fig, 3 Tab, 61 Ref.

Descriptors: \*Disinfection, \*Iron compounds, \*Viruses, Chlorine, Viricides, E. coli, Resistance, \*Waste water treatment, Water treatment, Organic compounds, Aquatic life, Environmental effects, Hydrogen ion concentration, Chlorination,

Potassium ferrate has been considered as a substitute for chlorine for the disinfection of water and waste waters. The effectiveness of ferrate (VI) as a viricidal agent against 12 virus has been tested in buffered, distilled water and secondary treated sewage effluent. The resistance of 12 virus and Escherichia coli to iron (VI) ferrate in buffered, distilled water was also studied. The inactivation of f2 virus was enhanced as pH decreased. In both pure and secondary effluent systems at concentra-tions of 1 ppm, potassium ferrate inactivated 99% of f2 virus in 22 minutes at pH 7.8, 5.7 minutes at pH 6.9, and only 0.77 minutes at pH 5.9. At pH 7.8, concentration of the disinfectant and time had equal effects. The resistance of f2 virus to potassium ferrate was the same as, or less than, that of E. coli inbuffered, distilled water at the pH levels tested. The disinfection reactions did not follow first order kinetics. The ferrate compounds were less affected than chlorine by changes in organic content, pH and temperature, while leaving no residual (as do halogenated disinfectants) to harm aquatic life. It was concluded that ferrate com-pounds would be good viricidal agents in raw and waste waters. (Geiger-FRC) W81-02137

# PHENOL AND FREE AMMONIA INHIBITION TO NITROSOMONAS ACTIVITY,

Pittsburgh Univ., PA. Environmental Engineering

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

#### Water Treatment and Quality Alteration-Group 5F

R. D. Neufeld, A. J. Hill, and D. O. Adekoya. Water Research, Vol 14, No 12, p 1695-1703, December, 1980. 8 Fig, 2 Tab, 11 Ref.

Descriptors: \*Nitrification, \*Biological treatment, \*Phenols, Model studies, Ammonia, Biodegradation, Microbial degradation, \*Waste water treatment, Hydrogen ion concentration, Kinetics, Oxidation, Industrial wastes, Nitrite, Sewage bacteria, Persiratives

In a study designed to elucidate the possible causes of the biological nitrification process instability found in many industrial waste water operations, the rate of ammonia bio-oxidation to nitrite by an autotrophic culture of strict nitrifiers was exam-ined. Laboratory tests were conducted using batch respirometric evaluations of Nitrosomonas cultures respirometric evaluations of Nitrosomonas cultures to quantify the effects of phenol and non-ionized (free) ammonia on biokinetic parameters. The nitrifying organisms used had been adapted to a synthetic ammonia waste, and received only inorganic carbon during the course of the experiments. Ammonia oxidation biokinetics followed Michaelis-Menten type relationships, while the influence of Menten type relationships, while the influence of non-ionized ammonia on ammonia oxidation was best described by a 'substrate-inhibition' Monod kinetics model. This model accounted for observed differences in ammonia bio-oxidation as a function of pH. The Michaelis-Menten constant varied with the square root of the ambient phenol concentration. Engineering design and operational considerations for the biological removal of ammonia in waste water are also examined. (Geiger-FRC) W81-02138

#### 5E. Ultimate Disposal Of Wastes

MILL'S CONVERSION OF SOLID WASTE INTO FUEL VIELDS ENERGY SAVINGS. Pulp and Paper, Vol 54, No 11, p 105-106, November, 1980. 1 Fig.

Descriptors: \*Wood wastes, \*Sludge disposal, \*Incineration, Solid wastes, \*Energy sources, \*Fuel, Waste water treatment, Ultimate disposal, Pulp and paper industry, Industrial wastes, Abitibi-Price Co., Disposal, Waste disposal, Flotation, Water pollution treatment, Sewage lagoons, Lagoons, Sattling begins Savage treatment, Protection pollution treatment, Sewage lagoons, L Settling basins, Sewage treatment, Bacteria.

Sludge from the Abitibi-Price Alpena, Michigan, hardboard mill is collected by dissolved air flotation, dewatered to a 15-25% solids content, dried to a 7-8% moisture content, and pelletized (average 1/8 inch diameter). These pellets are burned in combination with coal, saving 15% of the coal. The sludge is composed of dead bacteria which have digested the dissolved solids (essentially used description the secondary teatment enterprets and the se wood sugars) in the secondary treatment ponds Although this procedure is a break-even proposi-tion financially, elimination of the sludge disposal problem and improvement of environmental condi-tions are valuable benefits. (Cassar-FRC) W81-01995

A GUIDE TO REGULATIONS AND GUID-ANCE FOR THE UTILIZATION AND DISPOS-

AL OF MUNICIPAL SEWAGE SLUDGE. Environmental Protection Agency, Washin DC. Office of Water and Waste Management. DC. Office of water and waste management.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB81-108508,
Price codes: A04 in paper copy, A01 in microfiche.
Report EPA 430/9-80-015, September, 1980. 53 p,
1 Tab, 68 Ref. Pub. MCD-72 available from General Services Administration, Denver Federal
Center, Denver, Colorado 80225.

Descriptors: \*Municipal wastes, \*Sludge disposal, \*Legislation, \*Waste treatment, \*Ultimate disposal, Incineration, Impoundments, Landfills, Sludge treatment, Waste disposal, Treatment facilities.

This document is a supplement to the current EPA regulations and guidelines that need to be addressed, and the problems frequently encountered, when planning and operating a sewage sludge dis-position (utilization and/or disposal) facility, and should aid in the selection and implementation of

an appropriate disposition technique. Incineration, composting and surface impoundments are considered treatment and volume reduction methods, and landfilling, ocean disposal, land spreading, and distribution and marketing are considered ultimate utilization and disposal methods. Background information, applicable laws, regulations and guidelines, procedure needed for implementing the disposition method, problems frequently associated with the disposition method that are not covered by regulations and solutions to these problems, and by regulations and solutions to these problems, and references are provided for each disposition method. (Brambley-SRC) W81-02012

MINIMIZING SLUDGE HANDLING AND ENERGY REQUIREMENTS FOR ADVANCED WASTE WATER TREATMENT, Turnipseed (G. Ben), Inc., Atlanta, GA. For primary bibliographic entry see Field 5D. W81-02087

CONTROL OF MERCURY POLLUTION IN JAPAN AND THE MINAMATA BAY CLEANUP,

T. Ishikawa, and Y. Ikegaki.
Journal of the Water Pollution Control Federation,
Vol 52, No 5, p 1013-1018, May, 1980. 1 Fig.

Descriptors: \*Minamata Bay, \*Japan, \*Mercury, \*Water pollution control, Bottom sediments, Waste disposal, Waste treatment, Disposal, Marine life, Water pollution effects, Sludge disposal, Water treatment, Ultimate disposal.

As a result of mercury poisonings in Minamata, Japan, in 1956 and 1965, strict effluent standards became mandatory in Japan. Effluents must contain no greater than detectable limits (0.0005 mg per liter) of total Hg or alkyl Hg. Industrial plants using Hg processes have largely converted to non-Hg processes. Limits for seafood were set at 0.3 and grig processes. Limits for seafood were set at 0.3 mg per liter of methyl Hg and 0.4 mg per liter total Hg on a wet basis. Contaminated bottom sediments were removed in 33 of 42 specified sites by 1978. In Minamata Bay, sediment contains up to several hundred mg per liter Hg, probably as sulfides, in deposits 4 meters deep. Marine life is incurably poisoned. To avoid further water pollution by disturbing bottom sediments, plans for removal have been formulated. A temporary cofferdam will be built, into which the contaminated sediment will be pumped. Deredging will take place in this confined area. Methylation of mercury will be minimized by keeping the area flooded with sea water and protected from sunlight. Excess water will be purified before discharging. Marine life and water quality will be constantly monitored. This project, currently suspended under an injunction, is expectived to take 10 years to complete. (Cassar-FRC) W81-02097

HANDLING HAZARDOUS WASTE--AN UN-SOLVED PROBLEM, Environmental Defense Fund, Washington, DC. For primary bibliographic entry see Field 5B. W81-02146

#### 5F. Water Treatment and **Quality Alteration**

THE CONTROL OF ANIMALS IN WATER MAINS USING PERMETHRIN, A SYNTHETIC

MAINS USING FERMINANDERS AND AND ASSESSION OF STREET AND ASSESSION OF STREET AND ASSESSION OF STREET AND ASSESSION OF A STREET ASSESSION OF A STREET AND ASSESSION OF A STREET ASSES Tab. 7 Ref.

Descriptors: \*Aquatic insects, \*Pesticide toxicity, \*Permethrin, Water quality, Public health, Diptera, Rainbow trout, Insecticides, Distribution systems, Population, Resistance, Laboratory tests, \*Water treatment, Potable water, Gas chromato-

When supplies of the natural pyrethrin insecticide ing low, the Langford treatment works

began to test the synthetic pyrethroid insecticides, began to test me synthetic pyternroid insecticities, resmethrin, bioresmethrin and permethrin to control populations of chironomids in public water supplies. Permethrin toxicity to the larvae of the insect Paratanytarsus sp. and adults of Asellus insect Paratanytarsus sp. and adults of Asellus aquaticus, certain domestic aquarium fish (guppies, platies, and neon tetras), and young trout (Salmo gairdneri) were examined in laboratory tests. Insects were exposed to permethrin dose levels ranging from 0.001 to 0.025 mg/liter. Aquarium fish were exposed to dechlorinated tap water containing permethrin at levels of 0.025 mg/liter. No mortality occurred in trout exposed to 0.025 mg/liter of permethrin; however, the presence of fish caused reductions in water levels of permethrin when compared to tanks containing the insecticide when compared to tanks containing the insecticide but no fish. This was attributed to removal of permethrin by active surfaces on the fish. No mor-tality was observed among the aquarium fish tested. Permethrin toxicity to the insects tested showed a dose dependent relationship, with rapid showed a dose dependent relationship, with rapid paralysis in Asellus adults and narcotic action to Paratanytarsus larvae, permitting effective flushing. Chemical analyses of permethrin levels in water were carried out by a single column gas liquid chromatographic technique, which is described. A three year monitoring program was conducted on water samples from southend water mains to assess the effectiveness of the insecticide treatment on aquatic insects. The four categories found in greatest abundance, the Paratanytarsus larvae, Cladocera, Nais and the Limnochares, were similar to those found when pyrethrin was used. Unlike pyrethrin, permethrin dosing of the water system has prevented reinfestations of the water supply even after 90 weeks. These findings show the increased effectiveness of this synthetic pyreth-oid in controlling pathogenic chironomids, with roid in controlling pathogenic chironomids no detrimental effects on fish. (Geiger-FRC) W81-01905

PREVENTING HALOFORM FORMATION IN DRINKING WATER,

outh Dakota School of Mines and Technology, Rapid City.

L. L. Harms, and R. W. Looyenga

Available from the National Technical Information Avanause from the National Technical Information Service, Springfield, VA 22161 as PB81-144453, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-091, August, 1980. 101 p, 18 Fig, 16 Tab, 18 Ref, 11 Append. R805149-01-0.

Descriptors: \*Potable water, \*Distribution sys-tems, \*Trihalomethanes, \*Chlorination, South Dakota, Water purification, Disinfection, Environ-mental sanitation, Water pollution, Pipes, Land use, Turbidity, Water properties, Specific conduc-tance, Chloroform, \*Huron(SD).

The Huron, South Dakota, water distribution system was monitored for trihalomethanes at several locations. Deposits from within the distribution system were evaluated as potential precursor material and were found to be precursors for the haloform reaction. Field tests designed to determine the extent of trihalomethane formation that occurs as a result of the pipe deposits were inconclusive. The deposits appear to be a precursor source, but they do not substantially alter the terminal trihalomethane concentration. Ammonium sulfate was used to convert to a combined chlorine residual in the distribution system. A significan drop in trihalomethane concentrations was ob tained along with maintenance of adequate disinfection. Primary disinfection was obtained by lime softening followed by a free chlorine residual. Land used upstream from the raw water intake was evaluated for potential chloroform formation. Peak concentrations occurred near marshes, where cattle watered, and where the river was stagnant. Nine raw water quality parameters were moni-tored and correlated with trihalomethane forma-tion. The best correlations were obtained with specific conductance and turbidity. (Author's ab-W81-01933

CENTRAL LINCOLNSHIRE SCHEME MOVES AHEAD.

#### Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

#### Group 5F-Water Treatment and Quality Alteration

Water Services, Vol 84, No 1016, p 623-624, October, 1980. 1 Fig.

Descriptors: \*Water purification, \*Potable water, \*Lincolnshire(UK), \*Saltersford(UK), Limestones, Water sources, Groundwater, Nitrates, Surface waters, Reservoirs, Water supply, \*Water treat-

Improvement of water supplies in central Lincolnshire was commenced in 1978 by connecting reservoirs to allow transfer of water during seasons of volts to allow trainer of water during seasons or peak demand on the Central Limestone borehole sources. By 1982 the Saltersford Treatment Works, with a maximum capacity of 25,000 cubic meters per day, will be completed. The source of water per day, will be completed. The soldrec of water supply will be surface waters. In addition, a main connecting the treatment works with the town of Lincoln will allow the Central Limestone ground-water sources to be removed from service during periods of adverse water quality. (Cassar-FRC) W81-01956

REMOVAL OF ARSENIC FROM CONTA-MINTED DRINKING WATER BY A CHITO-SAN/CHITIN MIXTURE,

Saint Mary's Univ., Halifax (Nova Scotia). Dept. of Chemistry.

Or Chemistry. C. M. Elson, D. H. Davies, and E. R. Hayes. Water Research, Vol 14, No 9, p 1307-1311, September, 1980. 1 Fig, 2 Tab, 13 Ref.

Descriptors: \*Potable water, \*Arsenic, \*Ion exchange, \*Water treatment, Chelation, Separation techniques, Chitin, Chitosan, Canada, Water wells,

The efficacy of a chitosan/chitin mixture in removing arsenic from natural waters was investigated. When flakes of chitosan were stirred with a when takes to chross a were surface with a water sample, the pH of the mixture increased from 6.7 to over 8 and the arsenic level in the water remained constant at 0.1 ppm. However, holding the pH of the sample to between 5.5 and 6.5 with additional acid allowed the arsenic concentration to be lowered by 80% after 150 minutes centration to be lowered by 80% after 150 minutes of stirring. Flakes of chitin stirred with a water sample caused the pH to be decreased by 2 units and removed 25% of the arsenic. The mixture of chitosan/chitin removed certain polyoxy-anions including arsenate from water at a neutral pH. The capacity of the mixture was about 0.1 mu mol/g, which is 10,000 times smaller than the capacity of commercial lon-exchangers. The arsenic was bound to the polymers by a combination of electrostatic, ion-exchange attraction and chelation. (Baker-FRC) trostatic, ion-(Baker-FRC)

GEORGIA UNIVERSITY TEAM DEVELOPS WATER SYSTEMS GUIDE,

Georgia Inst. of Tech., Atlanta. T. N. Debo, and H. Wanning. Public Works, Vol 111, No 6, p 79-83, June, 1980. 6 Fig. 3 Tab. 1 Ref.

Descriptors: "Water treatment, "Potable water, "Local governments, "Publications, Georgia, Future planning, Water quality, Water resources development, Water management(Applied), Project planning, Universities, Water delivery, Costs, Water policy.

A coalition of members from Georgia's three leading universities - the Georgia Institute of Technoling universities - the Georgia Institute of Technology, the Georgia State University and the University of Georgia-was combined with a Local Government Advisory Committee to form an Inter-University Task Force (IUTF) to select and study local problems. During its first year in operation the IUTF opted to work on 'A Guide to Investments in Water Systems for Local Officials.' In 1977, revisions to the Safe Drinking Water Act of 1974 but the burden of providing safe and drink-1977, revisions to the Safe Drinking Water Act of 1974 put the burden of providing safe and drinkable water supplies on the local governments. The costs for providing such potable water have increased in recent years due to inflation. The guide was designed to aid officials in analyzing future large-scale capital improvements or expansion of publically-owned water systems. The 240-page guide is composed of 13 chapters and 2 appendices. Topics include background on small water systems, treatment and distribution processes, checklists of performance criteria, planning for system improvements, rate schedules and metering poli cies, preventive maintenance programs, emerge cies, preventive maintenance programs, emergency procedures, recording systems, state and federal regulations, budgeting and finance, consulting services, and government aid agencies. The guide was directed to small towns with populations of solutions of solut (Geiger-FRC) W81-01991

NEW YORK CITY'S PILOT PLANT FILTER STUDIES, PART TWO, Metcalf and Eddy, Inc., New York.

G. P. Fulton.
Public Works, Vol 111, No 5, p 85-88, May, 1980. 6 Fig, 3 Tab, 1 Ref.

Descriptors: \*Pilot plants, \*Water treatment, \*Filtration, Suspended solids, Turbidity, Data collections, Economics, Construction costs, Water supply, Flocculation, Settling velocity, Coagulation, Color, Water quality, Croton supply, New

In part 2 of a two part report, data evaluation of In part 2 of a two part report, data evaluation of information on New York's pilot plant filter studies being conducted on the Croton Supply is presented. The pilot tests proved to be well worth the investment, showing costs for a conventional plant based on the Ten-State Standards and a maximum filtration rate of 2 gpm per sq. ft. to be approximately \$147 million. The costs of the pilot plant studies were nearly negligible in comparison with the potential savings of more than \$14 million which represents the difference in construction costs of direct filtration and optimized conventioncosts of direct filtration and optimized conventional treatment. A unique ozone/diatomaceous earth filter process was also developed during the Croton study; this was effective in removing color and was more economical in construction costs than the granular process. The new procedure also showed economic advantages over conventional filtration during the settling step. The city of New York has decided to continue investigations into the ozone/diatomaceous earth process with larger scale facilities to refine design criteria, optimize efficiency through process and resource recovery measures, and determine adaptability to pending changes in the standards for organic constituents and disinfection. (Geiger-FRC) W81-01993

PACKAGE WATER TREATMENT PLANTS, VOLUME 2, A COST EVALUATION, Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div. R. G. Stevie, and R. M. Clark. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-102717, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-008b, July, 1980. 75 p. 25 Fig, 7 Tab, 8 Ref. 3 Aponend. Ref, 3 Append.

Descriptors: \*Water treatment, \*Treatment facilities, \*Cost-benefit analysis, Rural areas, Potable water, Water quality, Appalachian Mountain Region, Economics, Construction costs, Municipal water, Operating costs, Capital costs, Utilities, Recreational facilities, Kentucky, Tennessee, West

Many small and rural water treatment systems have high unit costs because of the small number have high unit costs because of the small number of service connections and they may have trouble meeting minimal drinking water standards. An alternative to conventional water treatment plants is the package water treatment plant, which is a self-contained unit. Data were collected for water quality and costs for 36 package plants, both municipal and recreational, in Kentucky, West Virginia and Tennessee. Utility costs were separated into four components: acquisition, treatment, distribution and support services. These plants can provide water that meets the turbidity requirements of the National Interim Drinking Water Standards. Scale economies are possible in package treatment plants treating under 1 million gallons per day and they can be used in a cost effective manner in small communities. (Brambley-SRC) W81-02015

URBAN WATER SUPPLY -- A STATISTICAL SURVEY,

National Building Research Inst., Pretoria (South Africa). Building Services Div. G. J. Malan.

Municipal Engineer (Johannesburg), Vol 10, No 4, p 9-11, 13-14, 16-19, July/August, 1979, 36 Tab, 3

Descriptors: \*South Africa, \*Water supply, \*Statistical methods, \*Surveys, Questionnaires, Measurement, Statistics, Piping systems(Mechanical), Water distribution(Applied), \*Rhodesia, Design criteria, Distribution systems, Utilities, Water deligents.

The results of a questionnaire on reticulation net-The results of a questionnaire on reticulation networks and water supply in buildings were statistically analyzed to provide a basis of comparison for municipalities needing to access their own standards. The questionnaires were completed by 54 local water authorities in South Africa, South-West Africa, and Rhodesia. Questionnaire items under reticulation included the following: hydrau under reticulation included the following: hydraulic design criteria, pipes and jointing for mains and service connections, corrosion protection, maintenance, pressure control, and installation. Items covered under supply to buildings included the following: metering, pipe sizing, materials, location, control, and fire fighting. Tables are used to show the number of replies giving each answer for each question. Certain aspects of urban water supply showed a general consensus. Inconsistencies in design and construction standards were also evident. Recommendations on certain practices are included. (Seigler-IPA) included. (Seigler-IPA) W81-02054

NOTES AND COMMENTS: THE PROBLEM WITH PERFORATED BAFFLES, W. Goodnow

Journal of the American Water Works Association, Vol 72, No 12, p 710, December, 1980.

Descriptors: \*Baffles, \*Settling basins, Flow, Basins, Flocculation, \*Water treatment, \*Kansas City, Kansas.

In a reply to a previous paper which stated that perforated baffles improve performance in rectangular settling basins, the author describes contrary results in a similar situation at the Kansas City, Kansas, Quindaro water plant. The perforated baffles caused poor distribution of flocculated water and degradation of large floc particles passing through the baffle perforations. These baffles were replaced with 13 manually adjusted pivoting vertical baffles and basin performance improved cal baffles, and basin performance improved. (Cassar-FRC) W81-02069

RESPONSE OF LEAD SOLUBILITY TO DIS-SOLVED CARBONATE IN DRINKING

Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div. For primary bibliographic entry see Field 5B. W81-02070

DESIGN OF AERATION TOWERS TO STRIP VOLATILE CONTAMINANTS FROM DRINK-

MALER, Montgomery (James M.), Inc., Washington, DC. M. C. Kavanaugh, and R. R. Trussell. Journal of the American Water Works Association, Vol 72, No 12, p 684-692, December, 1980. 9 Fig. 6 Tab, 19 Ref.

Descriptors: \*Aeration, \*Organic compounds, \*Water purification, Potable water, Water treatment, Trihalomethanes, Design criteria, Volatility.

### WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

W81-01960

Water Quality Control-Group 5G

Aeration using packed towers was used to remove trace organic contaminants such as trihalomethtrace organic contaminants such as trinatometh-anes from drinking water. There are 4 main consid-erations in design of a packed tower: air-to-water ratio, superficial water velocity (and thus the ratio, superficial water velocity (and thus the column diameter), type of packing, and depth of packing. The designer must also consider the coldest air and water temperatures, physical chemistry of the contaminant, and mass transfer characteristics of the packing. The design procedure is illustrated by an example using chloroform as the contaminant. Packing material is chosen first, in many cases polypropylene or polyvinyl chloride with low packing factors, and then the number of transfer units, allowable gas flow, column diameter, height of unit, a constant (overall liquid mass transier units, ailowable gas 100w, column diameter, height of unit, a constant (overall liquid mass transfer coefficient times interfacial area per volume of packing across which mass transfer occurs), packing height, and tower dimensions (1.5 times the calculated dimension for a safety factor) are added in. (Cassar-FRC) W81-02071

RESERVOIR COATINGS CAN SUPPORT BAC-TERIAL GROWTH, East Bay Municipal Utility District, Oakland, CA. W. M. Ellgas, and R. Lee. Journal of the American Water Works Associ-ation, Vol 72, No 12, p 693-695, December, 1980. 3

Fig, 1 Tab, 2 Ref.

Descriptors: \*Protective coatings, \*Storage tanks, \*Bacteria, Water distribution(Applied), Coatings, Epoxy resins, Linings, Plastics, Rubber, Reservoir storage, Resins, Vinyl resins, E. coli, Water districts, East Bay Municipal Utility District, Califoratics,

An ideal potable water reservoir coating was not An ideal potable water reservoir conting was not found in a study of 32 rubbers, vinyl resins, epoxy resins, polyurethanes, and other polymers. The most acceptable coating consisted of a 4-compomost acceptable coating consisted of a 4-component vinyl resin system-primer, white undercoat, and 'final gray topcoat,' with 'gray topcoat' as the final layer. Coatings were tested for bacterial growth support on 4 species: E. coli, Enterobacter aerogenes, Klebsiella oxytoca, and Pseudomonas p. In addition to bacterial considerations, the coating must not impart taste or odor to the water or contain excessive amounts of undesirable solvents.

Problems in selecting coatings involve changes in age, changes in manufacturer's formulations, and presence of toxic materials. (Cassar-FRC) W81-02072

SUBMARINE TRANSMISSION LINE: LIFE-LINE FOR VIEQUES,

Puerto Rico Aqueduct and Sewer Authority, Hato

Puero Nac. Rey. J. J. Mayol, and J. R. Goitia. Journal of the American Water Works Associ-ation, Vol 72, No 12, p 678-683, December, 1980. 6

Descriptors: \*Water distribution(Applied), \*Pipelines, Conduits, Water supply, Potable water, Submarine pipelines, Puerto Rico, Vieques, Conveyance structures, Closed conduits.

A submarine water transmission main from Puerto Rico to the island of Vieques, 10 miles away, insures an adequate, reliable supply of potable water for the island's 8,000 inhabitants. Inaugurated Feb. 10, 1978, this system was chosen as the most cost-effective over other alternatives--additional well-drilling, impoundment of surface runoff, and seawater desalinization. The main begins at the Puerto Rico Rio Blanco pumping station, runs 9,100 meters to a 12 diameter pipeline 3,600 meters long, and terminates at a 100,000 gal concrete tank 20 meters above sea level. The unconcrete tank 20 meters above sea level. The undersea section is 16' diameter lined carbon steel pipe 17,250 meters long and has a 17.2 meter difference in elevation from the Puerto Rico storage tank to the Vieques storage area, Arcadia reservoir. The pipeline does not follow a straight line under the water, because rock and coral formations interfere. Maximum depth of the pipeline is 17 meters. A 100,000 gal reservoir receives the water, which is pumped to a 250,000 gal concrete

reservoir. Customers receive water by gravity reservoir. Customers receive water by gravity through an existing pipe network. Funding, which totaled \$13,901,820, was received from the Puerto Rican government, Farmer's Home Administration, and PRASA revenues. (Cassar-FRC) W81-02073

RECENT DEVELOPMENTS IN FILTRATION

SYSTEM DESIGN,
Montgomery (James M.), Inc., Pasadena, CA.
R. R. Trussell, A. R. Trusell, J. S. Lang, and C. H.

Journal of the American Water Works Association, Vol 72, No 12, p 705-710, December, 1980. 6 Fig, 8 Tab, 8 Ref.

Descriptors: \*Design criteria, \*Filtration, \*Water treatment, Filters, Flocculation, Turbidity.

In determining water treatment plant filter efficiency, filtration rate and backwash volume can provide additional data to supplement the commonly used parameter, length of filter run. Effects of various variables on filter performance were determined in order to provide information for design considerations. Conventional filtration rates may be increased considerably without adversely affect-ing filter performance. On-off cycles should be limited to six per day to produce acceptable efflu-ent. Angular filtration media perform more satis-factorily than smooth media. As the ratio of depth of the medium to diameter of the media particles increases, filter performance improves, but to a lesser extent than equations predict. Multimedia filtration produces effluent quality to that of simi-lar dual media filtration, but requires shorter filter runs. (Cassar-FRC) W81-02074

INACTIVATION OF F2 VIRUS WITH FER-

Miami Univ., Coral Gables, FL. Dept. of Civil Engineering. For primary bibliographic entry see Field 5D. W81-02137

### 5G. Water Quality Control

DISTRIBUTION METHODS FOR TRANSFER-ABLE DISCHARGE PERMITS, Illinois Univ. at Urbana-Champaign, Dept. of Civil

Engineering.
J. W. Eheart, E. F. Joeres, and M. H. David.
Water Resources Research, Vol 16, No 5, p 833-843, October, 1980. 7 Fig. 4 Tab, 5 Ref.

Descriptors: \*Mathematical models, \*Water permits, \*Water rights, Model studies, Phosphorus, Discharge, Waste water treatment, Costs, Lake Michigan, Wisconsin, \*Waste water disposal permits, \*Effluent limitations, Water pollution con-

The policy of transferable discharge permits (TDP) is also known as the policy of pollution rights, marketable effluent permits and transferable residual permits. Under TDP policies, the agency charged with pollution control distributes permits allowing a certain quantity of a specified pollutant to be discharged. A mathematical model has been designed to simulate the operation of a single-price auction of TDP's. At the auction, the permits are auction of 1DF's. At the auction, the permits are sold by the controlling authority or are given away, free of charge, to the dischargers according to a pre-set formula. The TDP policies may be subsequently redistributed at a similar auction. A comparison of the sales method with four other free allocation schemes is presented for the hypothetical case of phosphorus discharge from point sources along the Wisconsin-Lake Michigan watershed. The first involves distribution of permits to municipal treatment plants in proportion to the average hydraulic load. The second allocates per-mits in proportion to the pollutant load. The third method distributes permits to waste water treat-ment plants in proportion to the total value of the property served by each treatment facility. The free distribution methods are more favorable for the dischargers. (Geiger-FRC)

ORGANICS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITERIA.

Nalesnik Associates Inc., Washington, DC. Environmental Protection Agency, Office of Water Regulations and Standards Report, October, 1980. 29 p. 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, \*Polychlorinated biphenyls, \*Phenols, \*Aromatic-compounds, Federal jurisdiction, State jurisdiction, Legislation, Water pollution sources, Effluents, Toxicity, Phthalate esters.

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for three organic compounds - phenol, phthalate esters and polychlorinated biphenyls (PCB's). The sources of these chemicals in water systems are given. Because of its toxicity and possible carcinogenicity the EPA has established a zero discharge PCB federal effluent standard for new and existing production facilities. The 1976 Quality Criteria for Water established the following water quality criteria recommendations: phenol - I microgram per liter; phthalate esters - 3 microgram per liter; and PCB - 0.001 microgram per liter, Individual criteria are presented for the states, for the District of Columbia, and for overseas jurisdictions. (Brambley-SRC) ley-SRC) W81-02016

INTERMITTENT STREAMS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITE-

NIA.
Nalesnik Associates Inc., Washington, DC.
Environmental Protection Agency, Office of
Water Regulations and Standards Report, September, 1980. 16 p. 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, \*Intermittent streams, \*Critical flow, Aquatic life, Federal jurisdiction, State jurisdiction, Legislation, Water utilization, Channels, Pollutants, Low flow.

This digest is intended as a general information resource containing excerpts from the individual Pederal-State water quality standards for intermit-tent streams. The EPA has recommended that water quality standards should protect specified uses of a waterway in critical low flow situations, and for intermittent streams, the Agency recom-mends that criteria be adopted to the extent necessary to assure that conditions in the streams or stream beds will not impair existing or designated stream ocus win not impair exasting or ucasginateu uses in the stream or in downstream waters. The 1976 Quality Criteria for Water recommends pol-ulant criteria for the protection of aquatic life and other stream uses during the minimum stream flow, which in many cases is the average sevenday low flow which occurs once in ten years. Individual criteria are presented for the states, the District of Columbia, and overseas jurisdictions. (Brambley-SRC) W81-02017

GENERAL PROVISIONS/FREEDOMS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/ FEDERAL CRITERIA.

Nalesnik Associates Inc., Washington, DC. Environmental Protection Agency, Office of Water Regulations and Standards Report, September, 1980. 35 p. 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, Water pollution effects, \*Waterways, \*Aesthetics, Aquatic life, State jurisdiction, Federal jurisdiction, Waste water(Pollution), Water pollution. Toxicity

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for general

### Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G-Water Quality Control

provisions or freedoms. These are general and encompassing statements providing for the aesthetic beauty of a waterway, and are not based on scientific rationale. The 1976 Quality Criteria for Water recommends the following aesthetic qualities criteria. All waters should be free from substances attributable to waste water or other dis-charges that: settle to form objectionable deposits; float as debris, scum, oil, or other matter to form float as debris, seum, oil, or other matter to form nuisances, produce objectionable color, odor, taste, or turbidity; injure or are toxic or produce adverse physiological responses in humans, animals, or plants; and produce undesirable or nuisance aquatic life. Individual criteria are presented for the states, for the District of Columbia, and for overseas jurisdictions. (Brambley-SRC) W81-02018

NITROGEN-AMMONIA/NITRATE/NITRITE; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/ FEDERAL CRITERIA. Nalesnik Associates Inc., Washington, DC. Environmental Protection Agency, Office of Water Regulations and Standards Report, Septem-ber, 1980. 18 p, 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, \*Nitrogen compounds, \*Inorganic compounds, Ammonia, Nitrates, Federal jurisdiction, State jurisdiction, Legislation, Toxicity, Water pollution sources, Nitrogen cycle, \*Inter-

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for ammonia, nitrate and nitrite nitrogen in interstate surface waters. The sources of each form of nitrogen in water are given. The rationale for establishing water are given. The rationale for establishing water quality criteria for these molecular forms of nitrogen are: (1) ammonia toxicity to aquatic life is well documented and its toxicity is directly dependent on the pH of the water in which it is dissolved: (2) growing plants assimilate nitrate and ammonium ions into plant proteins; and both nitrate and nitrite nitrogen are toxic to aquatic life where specific concentrations of either are reached in a waterbody. Individual criteria are presented for the states, the District of Columbia, and overseas jurisdictions. (Brambley-SRC) W81-02019

PESTICIDES; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITERIA.

OF STATE/FEDERAL CRITERIA.
Nalesnik Associates, Inc., Washington, DC.
Environmental Protection Agency, Office of
Water Regulations and Standards Report, October,
1980. 46 p, 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, \*Pesticides, Pesticide residues, \*Agricultural runoff, Federal jurisdiction, State diction, Legislation, Chlorinated hydrocarbon pes-ticides, Effluents, Water pollution sources, Herbi-

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for fifteen pesticides. The pesticides exert detrimental effects on aquatic and animal life; some are suspected mutagens or carcinogens. The EPA recommended ambient water quality criteria are listed for aldrin/ dieldrin, chlordane, chlorophenoxy herbicides, DDT, demeton, endosulfan, endrin, guthion, hep-tachlor, lindane, malathion, methoxychlor, mirex, tachior, lindane, maiathion, methoxychior, mires, parathion, and toxaphene. Their presence in water may be the result of agricultural or forestry application or production facility effluents. Individual criteria are presented for the states, the District of Columbia, and overseas jurisdictions. (Brambley-SPC) W81-02020

TEMPERATURE; WATER QUALITY STANDARDS; CRITERIA DIGEST; A COMPILATION OF STATE/FEDERAL CRITERIA.

Environmental Protection Agency, Washington,

DC. Office of Water Regulations and Standards. Report, July, 1980. 71 p, 7 Tab.

Descriptors: \*Water quality control, \*Water quality standards, \*Thermal pollution, Aquatic life. Fish, Federal jurisdiction, State jurisdiction, Legislation, Sea water, Fresh water.

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for water reueral-state water quality standards for water temperature. The standards are set to control ther-mal pollution caused by the discharge of heated wastes into bodies of water. The 1976 Quality Criteria for Water recommends that to protect freshwater aquatic life there is an upper limiting temperature for short-term time-dependent expo-sures and a limit on the weekly accept the standard of the sures and a limit on the weekly accept the support of the standard of the support of the sures and a limit on the weekly average tempera-ture. To protect marine aquatic life the maximum increase in weekly average temperature due to artificial sources may not exceed 1C and the daily temperature cycle may not be altered in amplitude or frequency. Individual criteria are presented for the states, for the District of Columbia, and for overseas jurisdictions. (Brambley-SRC) W81-02021

ANTIDEGRADATION POLICIES; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITERIA.

Nalesnik Associates, Inc., Washington, DC. Environmental Protection Agency, Office of Water Regulations and Standards Report, October, 1980. 44 p, 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, \*Water resources, Thermal pollu-tion, Federal jurisdiction, State jurisdiction, Legis-lation, Water utilization, Water quality, Natural resources, Water properties.

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for antidegradation policies. The EPA recommends that each state adopt an antidegradation policy into its water quality standards. The key concepts to be included as minimum requirements are (1) in all included as minimum requirements are (1) in an accase, existing instream beneficial stream uses must be maintained, (2) high quality waters must be maintained unless the State decides to allow limited degradation where economically or socially ed degradation where economically or socially justified (limited degradation is permitted to the extent at which water quality criteria necessary to sustain the national water quality goals uses are maintained); (3) outstanding national resource waters must be maintained and protected and; (4) thermal discharge limitations, as specified under Section 316(a) of the Clean Water Act as amended in 1977, will be correlated to the incompliance in 1977, will be considered to be in compliance with this policy. Individual criteria are presented for the states, the District of Columbia, and overseas jurisdictions. (Brambley-SRC) W81-02022

OTHER ELEMENTS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITE-

NIA.
Nalesnik Associates Inc., Washington, DC.
Environmental Protection Agency, Office of
Water Regulations and Standards Report, October,
1980, 23 p, 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, \*Trace elements, \*Metals, Aquatic life, Toxicity, Federal jurisdiction, State jurisdiction, Legislation, Water pollution sources, Irrigation water, Mollusks, Salmonids, Domestic water, Barium, Beryllium, Boron, Chlorine, Manganese, Nickel, Selenium, Silver.

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for eight elements usually incorporated into State Water Quality Standards. The elements are barium, beryllium. boron, chlorine, manganese, nickel, selenium, and silver. Some sources of these elements in water are given. The EPA's recommended ambient water

quality criteria to protect aquatic life and human health are given for each element for the waters for which they have been established. Criteria have been established for barium in domestic water supplies, beryllium in freshwater and irrigation waters, boron in irrigation waters, chlorine for salmonid fish and other freshwater and marine organisms, manganese in domestic water supplies and for protection of consumers of marine mollusks, nickel for freshwater and marine aquatic life, and selenium and silver in domestic water supplies and for marine and freshwater aquatic life. Individand for marine and freshwater aquatic life. Individ-ual criteria are presented for the states, for the District of Columbia, and for overseas jurisdic-tions. (Brambley-SRC) W81-02023

PHOSPHORUS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITERIA.

Nalesnik Associates, Inc., Washington, DC. Environmental Protection Agency, Office of Water Regulations and Standards Report, Septem-ber, 1980. 16 p. 57 Ref. WA-80-A055, 68-01-6058.

Descriptors: \*Water quality control, \*Water quality standards, \*Phosphorus, Phosphates, \*Estuaries, Aquatic life, Toxicity, Inorganic compounds, Federal jurisdiction, State jurisdiction, Legislation, Aquatic plants, Water pollution sources.

This digest is intended as a general information resource containing excerpts from the individual Federal-State water quality standards for phosphorus. The criteria are established to provide a threshold level which when exceedd would most likely result in aquatic life toxicity, due to element. interly result in aquatic life toxicity, due to elemental phosphorus, and excessive aquatic plant growth caused by phosphate phosphorus. The sources of phosphorus in water are given. The 1976 Quality Criteria for Water recommends a phosphorus criterion of 0.1 microgram per liter yellow (elemental) phosphorus for marine and estuarine waters. There is no freshwater criterion. Individual criteria are presented for the states, for the District of Columbia, and for overseas jurisdictions. (Brambley-W81-02024

FEASIBILITY OF WATER QUALITY IM-PROVEMENT IN THREE ILLINOIS RIVERS,

Arizona Univ., Tucson.

D. C. Wilkin, and R. C. Flemal.

Journal of the Water Pollution Control Federation, Vol 52, No 2, p 293-298, February, 1980. 10 Tab. 4

Descriptors: \*Water pollution sources, \*Illinois, \*Rivers, \*Water quality, Nitrogen compounds, Phosphorus compounds, Heavy metals, Boron, Chlorides, Copper, Coliforms, Fluorides, Iron, Lead, Manganese, Mercury, Nitrates, Phenol, Sulfates, Zinc, Dissolved solids, Pollutants, Water quality control, Feasibility studies.

Point sources are not the major contributors of pollutant loading in 3 Illinois rivers, the Upper Sangamon and the West and East branches of the DuPage. Therefore, limiting emissions from point sources would not appreciably improve water quality in these rivers without non-point source control. In the Upper Sangamon undefined sources were responsible for 84 to 99% of the total loads of ammonium and nitrate nitrogen, boron, chloride, fluoride, methylene blue active substances, phenol, total phosphorus, sulfate, and a variety of metals. Fecal coliform accounted for in this way was 62%. In the other 2 rivers, fractions were more variable, with higher percentages of metals coming from undefined sources. (Cassar-FRC) W81-02083

CHALLENGING COMBINED SEWER PROB-LEMS IN JAPAN,

Ministry of Construction, Ibaraki (Japan). Water Quality Control Dept. For primary bibliographic entry see Field 4C. W81-02103

### Techniques Of Planning—Group 6A

R&D AT EPA: UPHILL RESPONSIBILITIES AND DOWNHILL FUNDING, D. V. Feliciano.

Journal of the Water Pollution Control Federation, Vol 52, No 3, p 442-448, March, 1980. 2 Fig. 1

Descriptors: \*Government finance, \*Research and development, Technology, Grants, \*Water pollution control, Environmental Protection Agency, Anticipatory Research Program

Research and development within EPA has always dealt primarily with practical studies to support regulation. EPA's Anticipatory Research Program has made it clear that basic research is a vital component of the research and development done by the agency. Now, in the Office of Research and Development, special individual research projects can receive funding under the Innovative Research Programs and English these in Science and Trabasch. Program. Also, there is a Science and Technology Achievement Awards program to stimulate basic research. Significant research accomplishments by selected EPA scientists and engineers were cited in 1980, and financial awards presented totaled \$30,000. Funding and staffing remain tight for the Office of Research and Development due to fund-ing trends and inflation. (Small-FRC) W81-02113

GENERATION OF POLLUTING LOADS WITHIN RIVER BASINS,
National Inst. of Scientific Research, Quebec (On-

For primary bibliographic entry see Field 5B. W81-02134

### 6. WATER RESOURCES PLANNING

### 6A. Techniques Of Planning

A RESEARCH STRATEGY FOR ANTICIPATING CONTAMINANT THREATS TO AQUATIC RESOURCES.

Columbia National Fisheries Research Lab., MO. For primary bibliographic entry see Field 5C.

REAL-TIME FORECASTING WITH A CON-CEPTUAL HYDROLOGIC MODEL, I. ANALY-SIS OF UNCERTAINTY,

Iowa Univ. Iowa City. Inst. of Hydraulic Re-

P. K. Kitanidis, and R. L. Bras. Water Resources Research, Vol 16, No 6, p 1025-1033, December, 1980. 2 Fig, 1 Tab, 19 Ref.

\*Statistical methods, Forecasting, Phytrographs, Discharge measurement, Stochas-tic processes, \*Streamflow forecasting, Probability. \*Model studies, Mathematical models, Systems analysis, Methodology, Hydrography, \*Real-time forecasting.

The National Weather Service catchment model is a large, nonlinear conceptual model in a mode amenable to analysis of uncertainty and the utiliza-tion of real-time information to update system states and improve streamflow predictions. It produces accurate short-term forecasts of river flows from rainfall information in 6 hour intervals and discharge observations. It is based on state space discharge observations. It is obsect on state space formulation in continuous form, linearization of nonlinear elements, and integration over discrete time periods. Linearization is performed with the uncommon multiple-input describing function technique for most strongly nonlinear responses and Taylor expansion for the rest. Error in the and Laylor expansion for the rest. Error in the model stems from input uncertainty, parameter uncertainty, the initial state of the system, and model uncertainty. Correction for these errors is performed by updating systems states utilizing Bayes' theorem, stochastic descriptions of the output, and initial probability density functions. (Titus-FRC) W81-01962

REAL-TIME FORECASTING WITH A CON-CEPTUAL HYDROLOGIC MODEL. 2. APPLI-CATIONS AND RESULTS, IOWA Univ., Iowa City. Inst. of Hydraulic Re-

search

P. K. Kitanidis, and R. L. Bras. Water Resources Research, Vol 16, No 6, p 1034-1044, December, 1980. 9 Fig, 9 Tab, 7 Ref.

Descriptors: \*Statistical methods, \*Streamflow forecasting, Probability, \*Hydrologic models, Forecasting, Discharge measurement, Hydrography, Authematical models, Methodology, Hydrography, Systems analysis.

The application of a conceptual hydrologic model The application of a conceptual hydrologic model to a case study forecasting river discharges in the Cohocton River basin is discussed and evalated. Results indicate that the use of feedback significantly improves the overall forecasting capability of the model even when the model and input error of the model even when the moder and input error statistics are not perfectly known. Comparison with a linear adaptive black box model strongly favors the conceptual model for longer forecast lead times. The present formulation of the conceptual model for longer forecast lead times. tual model neglects timing errors which can appear in the rising limb of a hydrograph. Future research is needed to address uncertainty structure and the problem of compensating for errors in estimating the magnitude and timing of the hydrograph peak. (Titus-FRC) W81-01963

A LOGICAL APPROACH TO THE DESIGN STORM CONCEPT,
Institute of Hydrology, Wallingford (England).
J. C. Packman, and C. H. R. Kidd.
Water Resources Research, Vol 16, No 6, p 9941000 December 1989, 0 Eig 7 This 12 Ref. 1000, December, 1980. 9 Fig, 2 Tab. 12 Ref.

Descriptors: \*Streamflow forecasting, \*Design cri-teria, \*Urban hydrology, \*Design storms, Method-ology, Storm drains, Mathematical models, Flood profiles, Simulation analysis, Sewers, Drainage sys-tems, Pipes, Catchment basins, \*Flood frequency, Design floods.

The application of sensitivity analysis to the determination of flood return periods and design inputs for peak runoff in given return periods is discussed. Current practice in storm drainage design is to adopt arbitrary storm parameters. Sensitivity analysis determines the antecedent conditions and design storm that consistently give flows which design storm that consistently give flows which match an observed flood frequency distribution. Sensitivity analysis may be applied to various catchments to determine a stable set of inputs which can be applied generally for design purposes. Input may be generated by continuous simulation or by simulation in probability space, in the absence of sufficient field data. This methodology has been used in the Wallingford model, which was developed for ambiguitation in the United King. was developed for application in the United King-dom, and which has been calibrated. The methodology has application in designs for natural and urban catchments. (Titus-FRC) W81-01971

STUDY OF LITTORAL CURRENTS IN COSTA DEL SOL IN RELATION TO THE PLACE-MENT OF SUBMARINE OUTFALLS ENVISIONED IN THE COMPREHENSIVE TREAT-MENT PLAN. (ESTUDIO DE CORRIENTES LITORALES EN LA COSTA DEL SOL, EN RELACION CON LOS EMPLAZAMIENTOS DE EMISARIOS SUBMARINOS PREVISTOS EN EL PROYECTO DE SANEAMIENTO INTEGRATI GRAL), Ministerio de Obras Publicas, Madrid (Spain).

Aplicaciones Nucleares, Madrid (Spain). Aplicaciones Nucleares. E. Baonza, and A. Plata. Progress in Water Technology, Vol 12, No 1, p 345-367, 1980. 9 Fig. 1 Tab. 12 Ref.

Descriptors: \*Baseline studies, \*Ocean currents. \*Diffusion, \*Sewage, \*Treatment facilities, Mathematical models, Waste water treatment, Municipal wastes, Water pollution sources, \*Costa del Sol(Spain), \*Mediterranean Sea, Planning, Construction, Sewage treatment plant, Data collections, Tracking techniques, Radioactive tracers.

A study was made of marine currents in the area of the proposed Costa del Sol sewage treatment plant using the radioactive tracer, bromine-82. The plant will remove suspended solids and floating solids and will affect two 100 km zones, one to the east and one to the west of Malaga. The waste water will be discharged into the sea, and the study was designed to find the most suitable discharge points. Over a period of two years, 146 tests were carried out. A mathematical model was developed and used to determine dilution at various distances from each discharge point tested. Known data were used to verify the model. (Small-FRC) W81-01975

GROUNDWATER MODELS FOR WATER RESOURCES PLANNING,
Geological Survey, Reston, VA. Water Resources

For primary bibliographic entry see Field 2F. W81-02035

HYDROLOGY OF SELECTED BASINS IN THE WARRIOR COAL FIELD, ALABAMA-A PROGRESS REPORT, Geological Survey, Tuscaloosa, AL. Water Re-

sources Div. C. Puente, J. G. Newton, and T. J. Hill.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-104754, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-22, March, 1980. 62 p. 18 Fig. 20 Tab, 23 Ref.

Descriptors: \*Baseline studies, \*Coal mining, \*Hy-Descriptors: "Baseine studies," Coal mining, "ry-drologic data, Surface waters, Groundwater resources, "Water quality, "Alabama, Mine drainage, Coal mine wastes, Hydrogeology, Data collections, Water analysis, Streamflow, Flow characteristics, Sediment yield, Water wells, Water yield, Water chemistry, Analytical techniques, "Warrior coal fold (ALI). coal field(AL).

Hydrologic data are being collected in four basins in the Warrior coal field in Alabama to provide baseline information to aid in determining the effect mining will have on water resources. Basins monitored are in two different geologic and hydro-logic environments. Two basins are underlain predominantly by relatively impermeable indurated rocks in the Pottsville Formation of Pennsylvanian age. The two remaining basins are underlain pre-dominantly by unconsolidated permeable rocks in the Coker Formation of Late Cretaceous age. Well yields from the Pottsville Formation generally range from 0 to 0.3 liter per second, whereas well yields from the Coker Formation generally range form 0.3 to 6.4 liters per second. Streamflow distri-bution reflects seasonal precipitation. Storm runoff is characterized by sharply concentrated flows of short duration that rapidly recede to low-flow conditions. Streams draining basins underlain chiefly by the Pottsville Formation frequently go dry, ly by the Pottsville Formation frequently go dry, whereas those draining basins underlain chiefly by the Coker Formation have well sustained low flows. Water in the Pottsville Formation is slightly acidic and moderately hard to very hard. Dissolved solids concentrations ranged from 176 to 268 milligrams per liter. Water in the Coker Formation is soft, far less mineralized, and more acidic than water in the Pottsville. Surface water is generally soft acidic and low in dissolved solids concently soft acidic and low in dissolved solids conerally soft, acidic and low in dissolved solids con-centrations. Water in streams draining basins underlain chiefly by the Pottsville Formation was slightly more mineralized and less acidic than water in streams draining the Coker Formation. (USGS) W81-02038

BASELINE WATER QUALITY OF SCHMIDT, HORNBEAM, AND HORSESHOE LAKES, DAKOTA COUNTY, MINNESOTA, Geological Survey, St. Paul, MN. Water Re-

sources Div.

G. A. Payne.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-105645, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey, Water-Resources Investiga-

### Field 6—WATER RESOURCES PLANNING

### Group 6A-Techniques Of Planning

tions 80-3, 1980. 38 p. 2 Fig. 2 Tab, 8 Ref.

Descriptors: \*Baseline studies, \*Road construction, \*Water quality, \*Lakes, \*Minnesota, Eutrophication, Water analysis, Chemical properties, Physical properties, Biological properties, Limnology, Data collections, Sampling, Sites, Nutrients, Phytoplankton, Aquatic algae, \*Dakota County(MN).

Three lakes in Dakota County, Minn., were sampled five times during an 18-month period to determine baseline water quality prior to construction of an interstate highway. Results of physical meas-urements and chemical analyses showed that the lakes were shallow, nonstratified, and nutrient en-riched. Considerable seasonal variations in dis-solved solids, nutrient, and dissolved-oxygen concentrations were observed. Oxygen depletion and high nutrient concentrations were characteristic of conditions under an ice cover in winter. Blueconditions under an ice cover in winter. Bluegreen algal blooms typically were established soon after ice breakup and persisted until late fall. Data from the study will be supplemented with data collected during and after construction of the highway to assess the impact of highway construction and drainage on water quality of the lakes. (USGS) W81-02039

DIGITAL MODEL OF THE BAYOU BAR-THOLOMEW ALLUVIAL AQUIFER-STREAM SYSTEM, ARKANSAS, Geological Survey, Little Rock, AR. Water Re-

J. E. Reed, and M. E. Broom. Geological Survey Open-File Report 79-685, 1979. 94 p, 10 Fig, 13 Tab, 8 Ref.

Descriptors: "Model studies, "Mathematical models, "Alluvial aquifers, "Arkansas, "Water re-sources development. Groundwater, Surface-groundwater relationships, Forecasting, Potentio-metric level, Storage coefficient, Transmissivity, Withdrawal, Irrigation, Mississippi River, Arkansas River, \*Bayou Bartholomew

A digital model of the Bayou Bartholomew aquifer-stream system in Arkansas was calibrated for the purpose of predicting hydrologic responses to stresses of water development. The simulatedtime span for model calibration was from 1953 to 1970, during which time the system was stressed largely by ground- and surface-water diversions for rice irrigation. The model was calibrated by comparing groundwater-level and streamflow data with model-derived groundwater levels and streamflow. In the calibrated model, the ratio of model-derived to observed streamflows for 17 subbasins averaged 1.1; the ratios among the subbasins ranged from 0.8 to 1.6. The average deviation of the differences between model-derived and observed groundwater levels at 47 nodes was 0.2; the average among the nodes ranged from -2.3 to 10.4. The average standard deviation of the differences between the model-derived and observed groundwater levels was 3.5; the average among the nodes ranged from 0.4 to 10.5. The model will provide ranged from 0.4 to 10.5. The model will provide projections of changes in the potentiometric surface resulting from (1) changes in the rate or distribution of groundwater pumpage or (2) changes in the stage of streams and reservoirs. The model will provide only approximate projections of the streamflow. (USGS) W81-02044

COMPREHENSIVE BASIN-WIDE PLANNING OF SEWER SYSTEMS, Ministry of Construction, Tokyo (Japan). Dept. of

Sewerage and Sewage Purification Y. Kameda.

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 884-889, May, 1980. 2 Fig, 1 Tab.

Descriptors: "Sewerage, "Comprehensive planning, "Legislation, Forecasting, Sewers, Water quality, Future planning(Projected), City planning, "Japan.

Comprehensive basin-wide planning of sewer sys-tems in Japan is regulated by the 1970 version of the Sewerage Law. Prefectural governments are required to develop comprehensive sewerage pro-

grams which will help the area meet necessary water quality standards. Public waters requiring basin-wide planning are those that are polluted basin-wide planning are those that are polluted with discharges from two or more municipalities and for which water quality protection cannot be attained without the construction of a sewer system. The first step in planning is the determination of allowable load from the existing load at the source, the existing discharged load, and the ambient loads of the receiving body of water. Future pollution loads are estimated, and the required load setting the statement of the pollution is determined. reduction is determined. Naturally it is difficult to determine all of these parameters precisely, but strict precision is not necessary for basic planning. The required waste water treatment process level is then calculated. Urban areas with a population density of 40 persons/ha or more must be covered by such plans. Alternative waste water treatment options are always considered. (Small-FRC) W81-02102

STOCHASTIC APPROACH TO TREATMENT PLANNING. WASTE

IREAIMENI PLANNING. Utah Water Research Lab., Logan. R. D. Hansen, A. B. Bishop, and R. Narayanan. Journal of the Water Resources Planning and Man-agement Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR1, p 275-287, March, 1980. 3 Fig. 5 Tab, 11 Ref.

Descriptors: \*Stochastic processes, \*Waste water treatment, \*Planning, Model studies, Ashley Valley, \*Utah, Mining, Population, Decision making, Mathematical models, Economics, Water resources development, Agriculture.

Planning public works, such as waste treatment plants, for areas facing uncertainty in economic events and population size is difficult. In the model described in this paper, a stochastic futures submo-del, structured as a first-order Markov chain, is linked to a decision model. The model is applied to nnked to a decision mode: I ne mode is applied to a study of Ashley Valley, Utah, an isolated rural area with uncertain growth prospects. Tables are developed listing 3 types of possible development (oil shale, a water resource and agricultural water ton snae, a water resource and agricultural water project, and tar sands and phosphate mining) and 3 possible years (1980, 1985, 1990). This information, plus the costs of 4 sizes of waste water treatment units and damages caused by discharging untreated effluent, are used to determine the most cost-effec-tive sizing and sequencing of waste treatment for the Ashley Valley area. (Cassar-FRC) W81-02122

FAIRNESS CONSIDERATIONS AND ALTER-

NATIVE POLICIES,
Duke Univ., Durham, NC. Dept. of Civil Engi-

J. J. Peirce, E. F. Joeres, and M. H. David. Journal of the Water Resources Planning and Man-agement Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR1, p 81-87, March, 1980. 9 Ref.

Descriptors: \*Planning, \*Alternative planning, \*Fairness, \*Decision making, Administration, Management, Methodology, Water pollution, Phosphorus compounds, Wisconsin.

This paper offers aid to water resource planners in generating fair alternative solutions to problems within the scheme of rational planning. Some fair solutions are based on the following definitions: contractural agreement (example, a group of induscontractural agreement (example, a group of indus-trial polluters jointly contract with a party to remove the undesirable material), precedent (any plan enacted in the past for a similar problem), market system (enables participants to interact in the open market and achieve a competitive price equilibrium), egalitarianism (all polluters are treatequilibrium), egalitarianism (all poliuters are treated equally and must meet the same emission standards). Groups of equals are treated equally within the group, but unequal groups are treated according to need, worth, ability to pay, who receives benefits, and existing technology. Seventeen alternatives were developed to help solve the phosphorus problem in Wisconsin. Advantages of this method are (1) it allows for development of truly different alternatives, (2) it is efficient and flexible different alternatives, (2) it is efficient and flexible (3) it complements existing problem-solving methods. (Cassar-FRC)

W81-02125

### 6B. Evaluation Process

COMBINED SEWER SYSTEM ANALYSIS USING STORM AND SWMM FOR THE CITY OF CORNWALL, Gore and Storrie Ltd., Ottawa (Ontario).

For primary bibliographic entry see Field 5D. W81-01922

ENERGY CRITERIA FOR WATER USE, Florida Univ., Gainesville. Center for Wetlands. F. C. Wang, H. T. Odum, and R. Costanza. Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR1, p 185-203, March, 1980. 10 Fig, 3 Tab, 24 Ref.

Descriptors: \*Water resources development, \*Energy, \*Mathematical models, Water management, Water utilization, Energy budget, Energy transfer, Flow, Model studies, Land use, Energy loss, Simulation analysis, Economics, Ecosystems.

The problems of land and water management have been addressed by a synthesis of theories from energy analysis, ecology and economics to arrive at optimum management techniques. It was assumed that water resources could be assessed in terms of their embodied energy content, which was calculated as the amount of energy required directly and indirectly to generate the flow in processes of the biosphere or a typical desalination plant. The flow produced by water use in an agricultural system or an urban economy was used to calculate the energy effect of water. The energy effect of water was compared with its embodied effect of water was compared with its embodied energy. An energy-quality value was utilized to put environmental and economic variables in a comparable unit. The general objective function of this unit was the maximum power principle, a self-organizing and optimizing criterion. A land use organizing and optimizing criterion. A faint as model representing the major land-use systems (agricultural, natural, industrial, and urban) was constructed and transformed into a standard linear programming problem. Parametric analysis was oyed to obtain simulation results. The energy terms and concepts presented were recommended for use in organizing large ecosystems and in making decisions on water resource management in terms that may be easily compared with other questions on energy storage and supplies. (Geiger-FRC) W81-02008

WATER AND POWER RESOURCES SERVICE PROJECT DATA. Water and Power Resources Service, Denver, CO.

Engineering and Research Center.
For primary bibliographic entry see Field 8A.
W81-02011

ENERGY ANALYSIS FOR ENVIRONMENTAL IMPACT ASSESSMENT, Florida Univ., Gainesville. Center for Wetlands. F. C. Wang, H. T. Odum, and P. C. Kangas. Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR2, p 451-466, July, 1980. 4 Fig. 6 Tab, 21 Ref.

Descriptors: \*Decision making, \*Environmental effects, \*Power plants, Land use, \*Energy, Planning, Natural resources, Flood plains, Mathematical studies. Economics.

Two powerplant sites are evaluated by energy analysis to determine minimum loss of economic potentials and depletion of natural resources. Many potentials and depletion of natural resources. Many of the terms in the energy equations pertain to the energy inherent in various forms of water, e.g., rain, streams and floods. The examples illustrate the environmental impact of the powerplants on different types of land converted to powerplant and cooling pond use, acquirithting land of the powerplant. and cooling pond use-agricultural land or forested flood plain. The optimum choice of plant location is the forested flood plain if it is based on the loss

### Water Demand-Group 6D

to the economy of total environmental energy flows; and the agricultural land if the decision is based upon depletion of natural resources. (Cassar-FRC) W81-02120

### 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

## A COST-BENEFIT ANALYSIS OF WATER USE

RESTRICTIONS,
Johns Hopkins Univ., Baltimore, MD. For primary bibliographic entry see Field 3D. W81-01952

# CASE STUDY ON WATERLOGGING AND SA-

LINITY PROBLEMS IN PAKISTAN, National Engineering Services, Lahore (Pakistan). For primary bibliographic entry see Field 3F.

# DISTRIBUTION METHODS FOR TRANSFER-ABLE DISCHARGE PERMITS, Illinois Univ. at Urbana-Champaign, Dept. of Civil

Engineering. For primary bibliographic entry see Field 5G. W81-01960

# COST-EFFICIENCY OF TRANSFERABLE DISCHARGE PERMITS FOR THE CONTROL OF BOD DISCHARGES,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering. J. W. Eheart.

Water Resources Research, Vol 16, No 6, p 980-986, December, 1980. 3 Fig, 1 Tab, 12 Ref.

Descriptors: \*Biological oxygen demand, \*Permits, \*Cost comparisons, Project planning, Water policy, Administrative agencies, Costs, Economics, Analysis, Cost-benefit ratio, Water quality.

The process of designing a system of transferable discharge permits is discussed and four proposed systems for biological oxygen demand control are compared to least-cost and minimum uniform treatment strategies for achieving the same water quality. Transferable discharge permit systems treat discharges as pollution rights which can be bartered and purchased. A system must include assurance of favorable environmental outcome, administrative simplicity, equity, and cost minimization. The four proposed policies each establish a dissolved oxygen impact coefficient and a definition hasis for the nermit. Mathematical models are genbasis for the permit. Mathematical models are gen-erally required. All four versions of the transferable discharge permit were found to be cost efficient and below the minimum uniform treatment cost. Further research is needed to determine if the salient statistical properties of the systems are typical over a wide range of rivers and other water courses. Legal feasibility, procedures for enforcement, and detailed administrative structures must also be determined. (Titus-FRC) W81-01967

## FINANCING WASTE WATER TREATMENT IN

JAPAN, Ministry of Construction, Tokyo (Japan). Dept. of Sewerage and Sewage Purification. K. Inaba.

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 878-883, May, 1980. 1 Tab.

Descriptors: \*Financing, \*Government finance, \*Treatment facilities, Bond issues, Cities, Waste water treatment, Construction costs, Operating costs, Maintenance costs, \*Japan.

The past and present financing practices and the current financial structure of waste water treatment in Japan are described, and the prospects for the future are discussed. The Research Committee on Sewage Works Financing has recommended various financing schemes to meet the cost for construction of waste water treatment facilities and operating and maintenance costs. These involve

some combination of government subsidies, assessments, and municipal funds. The present fiscal policy emphasizes public service. Every household poincy emphasizes pulon service. Every household in an area where sewerage is available is required by law to use it. Sixty percent of the total construction costs of public sewerage facilities are eligible for central government subsidy. This subsidy covers two-thirds of the construction costs of the plant and six-tenths of the construction costs of the piant and six-tentus of the construction costs of the sewers. Local government bonds cover 85% of the subsidized part. Ninety-three percent of total regional facility construction costs are eligible for government subsidy. Ninety percent of non-subsi-dized costs are covered by bond issue. (Small-FRC) W81-02101

### SEWER USER CHARGES IN OSAKA,

Japan Water Works Bureau, Osaka. K. Takesada. Journal of the Water Pollution Control Federation, Vol 52, No 5, p 985-991, May, 1980. 2 Fig, 5 Tab.

Descriptors: \*Waste water treatment, \*Sewerage, \*Use rates, Prices, Osaka, \*Japan, Maintenance costs, Operating costs, Cost sharing, Costs, Rates, Planning, \*Water rates.

The city of Osaka has the highest population density in Japan, 2.7 million per 184.1 sq km area. Operation and maintenance costs for its sewer system, which serves 97.3% of the total city population, were 21 billion yen in fiscal 1979 (210 yen = 1 U. S. dollar), and capital costs including interest and depreciation, 22.3 billion yen. Sewer user charges began in 1920 and have been changed several times. The latest revision in 1972 changed the meter-rate system to the progressive-rate system in which a unit price per 1 cu meter increases with quantity of water used. A water quality surcharge, accounting for 4% of the sewer use revenues, is applied to substances that can be treated at treatment facilities, waste water of poorer quality than domestic waste water, and waste water approved by the city. Future plans include advanced treatment for water discharges into lakes and node, source of secondary affluent and shakes advanced treatment for water discharges into lakes and ponds, reuse of secondary effluent and sludge, and energy-saving measures. (Cassar-FRC) W81-02109

### 6D. Water Demand

## OUTDOOR RECREATIONAL USE AND PAR-TICIPATION INVENTORY OF THE LAKE MEAD NATIONAL RECREATION AREA,

Arizona State Univ., Tempe. Dept. of Leisure W. Greey, G. W. Cheatham, and R. J. Virden.

G. W. Creety, C. W. Cheatnam, and R. J. Virden. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-178378, Price codes: A18 in paper copy, A01 in microfiche. Technical report prepared for the Water and Power Resources Service, November, 1980. 412 p, 327 Tab, 2 Append. 14-06-300-2532.

Descriptors: \*Recreation, \*Reservoirs, \*Use rates, \*National Recreation Areas, Boating, Camping, Swimming, Sport fishing, Water utilization, Arizo-na, Nevada, \*Lake Mead National Recreation

Area.

For purposes of study and data collection, the Lake Mead National Recreation Area (LMNRA) was geographically divided into two separate regions: Lake Mead and Lake Mohave. The period of study was January 1, 1979 through December 31, 1979. Random sampling techniques were used to determine specific periods of data collection. During the study year, a total of 674,383 recreation units visited the Lake Mead Region, and 234,804 visited the Lake Mohave Region for a combined total of 909,187 units visiting the LMNRA during the study year. The projected number of visitors was 2,282,322 for the Lake Mead Region, and 775,861 for the Lake Mohave Region for a combined total of 3,058,182 during the same period. By rank order and frequency, visitors to the LMNRA participated in picnicking (2,919,272), swimming/related (1,898,913), boating (728,352), point of intermittent visit (702,460), camping (665,151), fish-

ing (333,571), boat camping (138,659), houseboating (90,642), and a variety of other activities (143,039 combined). Lake Mead accounted for 54.8% of all water based participation while Lake Mohave accounted for 45.2% of all water based participation within the LMNRA during the study year. Combined water based participation totalled 881,953 or approximately 13% of all visitor partici-pation. By rank order preference, Lake Mead visipation. By rank order preference, Lake mead visi-tors participated in swimming (228,950), fishing (101,283), and boat camping (60,617). Lake Mohave visitors participated in swimming (193,951) fishing (103,962), and boat camping (78,042) during the same period. (Moore-SRC) W81-01937

# STRATEGY FOR IRRIGATION DEVELOP-MENT IN EGYPT UP TO THE YEAR 2000, Ministry of Irrigation and Sudan Affairs, Cairo

For primary bibliographic entry see Field 3F. W81-01950

# THE ELEMENTS OF QUALITY AND SOCIAL COSTS IN RURAL WATER SUPPLY AND UTI-

Ibadan Univ. (Nigeria). Dept. of Geography. F. O. Akintola, O. Areola, and A. Faniran. Water Supply and Management, Vol 4, No 4, p 275-282, 1980. 1 Fig, 7 Tab, 5 Ref.

Descriptors: \*Water resources development, \*Rural areas, \*Surveys, Wells, Water quality, Water utilization, Water demand, Water distribu-tion, Agriculture, Social aspects, Water require-ments, Ponds, Domestic water, Future planning, \*Water costs, Water supply, Nigeria.

A survey was taken of village households in Ibarapa, Oyo State, Nigeria to determine water use patterns as background information for use in plan-ning rural water supply improvements. The survey sought data on the size of each household, number of livestock, daily water requirements, sources of water during various seasons, water use from each source, and social and economic costs of rural water supplies. Oyo state lies between the Ogun water supplies. Oyo state lies between the Ogun and Oyan rivers, and only four settlements in the area have pipeline water supplies. The main occupation of the villagers is farming. Springs and ponds provided most of the people's water needs, which averaged a maximum of 26.1 liters/individual/day. Wells and dugout stream beds were more important as sources of water during the dry season. Definite preferences of water sources were hours for different beneath of the states. shown for different household uses. On the average one hour was spent for each round trip to the age one hour was spent for each round trip to the water source during the wet season, while double that amount of time was needed to fetch water during the dry season. The most common water-borne disease among the villagers was guinea-worm infection, which caused an average of 126 lost work days per year. Dysentery, rheumatism, cough and other ailments were also linked to water supplies and added to the number of work days per year. The season of the supplies and added to the number of work days persent. missed. It was deduced that pipeline water supplies to rural areas would increase the number of man-hours alloted to farm work by reducing the time hours alloted to farm work by reducing the time spent fetching water and by reductions in work days lost due to water-borne diseases. Since the Savanna region of Ibarapa supplies most of Nigeria with food from its agriculture, the possible eco-nomic consequences of improved rural water sup-plies for the whole population of this nation should be considered. (Geiger-FRC) W81-01954

# A FIRST IN SOUTH AFRICA: THE STEEN-BRAS PUMPED STORAGE SCHEME.

For primary bibliographic entry see Field 8C. W81-02051

#### RAND WATER BOARD,

Rand Water Board, Johannesburg (South Africa). R. J. Laburn.

Imiesa (Johannesburg), Vol 4, No 5, p 48-49, 51, May, 1979. 3 Fig.

### Field 6-WATER RESOURCES PLANNING

### Group 6D-Water Demand

Descriptors: \*South Africa, \*Rand Water Board, \*Vaal River, \*Water supply, Reservoirs, Water distribution(Applied), Water supply development, Water tratement, Water management(Applied), Water purification, Water rates, Pumping, Utilities, water purification, Water rates, Pumping, Utilities, Water delivery

The Rand Water Board, organized in 1903, is a non-profit, autonomous public utility that supplies water in bulk to municipalities and other local authorities, to the mining industry, and to the South African Railways of the Witwatersrand area of South Africa. In 1923 the Board built the Barrage in the Vaal River in cooperation with the Department of Water Affairs. The Board is allowed to abstract, in perpetuity, 886, 470 cu m of water per day for no cost. The Board also abstrats additional water from the reservoir for a fee. The Roard has two main water purification stations on additional water from the reservoir for a fee. The Board has two main water purification stations on the Vaal River. The stations use chemical coagulation, sedimentation, filtration, and disinfection. Continuous pumping is then used to move the purified water to the central Witwatersrand divide where it gravitates to northern, eastern and westwhere it gravitates to northern, eastern and western regions. Local water authorities are responsible for boosting the water to their highest lying urban areas. The Rand Board's service reservoirs mainin a 36 hour supply with consumers being required to draw water at a near uniform rate. Consumer rates apply uniformly with no variations due to supply or location. The Board currently has two developments underway to ensure its continuing performance. (Seigler-IPA)

DURBAN'S WATER SUPPLY. Durban City Engineer's Dept. (South Africa). D. C. Macleod. Imiesa (Johannesburg), Vol 4, No 5, p 37-41, May,

Descriptors: \*South Africa, \*Durban, \*Water supply, \*Water sources, Urbanization, Water re-sources, Gravity, Metering, Water demand, Popu-lation, Water storage, Silting, Diversion, Dams,

The Borough of Durban, South Africa has had The Borough of Durban, South Africa has had various water sources since its declaration in 1854 including primitive wells, the Umbilo River, the Umbilatuzana River, the Umgeni River. The area has been troubled by heavy siltation of its reservoirs and currently uses a three-dam system composed of the dams at Nagle, Nidmar, and Albert Falls. A universal metering program started in 1970 produced an overall reduction in demand and a period of recession has program started in 1970 produced an overall reduction in demand and a period of recession has further reduced demand. Despite these reductions in demand, it is estimated that in the 1990's the assured yield of the Umgeni River will not meet the requirements of the area. One possible new water source would be the diversion of the upper water source would be the diversion of the upper waters of the Umkomas River into the head waters of the Ungeni River. This is considered desirable as it would permit gravity supply to the Durban Metropolitan Area. Another possibility is drawing water from the Illovo River and diverting the lower reaches of the Unkomaas River. (Seigler IPA) W81-02067

### 6E. Water Law and Institutions

THE ELEMENTS OF QUALITY AND SOCIAL COSTS IN RURAL WATER SUPPLY AND UTI-

Ibadan Univ. (Nigeria). Dept. of Geography. For primary bibliographic entry see Field 6D. For primary W81-01954

WATER IN THE ENVIRONMENT: THE UNEP EXPERIENCE,

United Nations Environment Programme, Nairobi

(Nenya). L. E. Obeng. Water Supply and Management, Vol 4, No 3, p 155-170, 1980. 18 Ref.

Descriptors: \*Reviews, \*Water resources develop-ment, \*United Nations, Water quality, Water

supply, Water pollution, Water reuse, Governments, Hydrology, Rural areas, Cities, Organizations, Water management, Education, Social as-

The importance of water to all life forms, productivity, and the quality of life is reviewed, along with the activities of international agencies that seek to enhance the quality and services afforded by the earth's water resources. Many United Nations (UN) agencies are in existence which deal with the use of water at the domestic, industrial, and agricultural levels. Since the first UN Conferand agricultural levels. Since the first UN Conference on the Human Environment, major world conferences have taken place that have emphasized topics related to water. The UN Environment Program (UNEP) Governing Council has been described as the central institution for environmental matters in the UN. Other agencies involved with water programs are the Center for Natural Resources, Energy and Transport, UNESCO's International Hydrological Program, FAO, WHO and about 25 other groups. Many of the programs of these agencies focus on some aspect of water quality or quantity. Other groups focus their activities ity or quantity. Other groups focus their activities on water pollution, irrigation, and data collections on general hydrology. The work of the agencies aids the UN in concentrating social efforts in developing countries in areas where they are most needed. Surveys conducted in 91 developing naneeded. Surveys conducted in 91 developing na-tions by the Governing Council have shown that 78% of 313 million people in rural areas and 23% of 450 million people in urban areas were without adequate water supplies. Improvements in water quality in third world nations have lessened the spread of water-borne diseases. The development of dams and irrigation systems in these nations has also helped to increase the acreage of farmable land and with it, food supplies. Certain UN agencies, especially UNICEF and UNEP, are involved in the education and training of individuals in the skills of water management. (Geiger-FRC) W81-01955

DROUGHT MITIGATION STRATEGY: CON-JUNCTIVE USE IN SMITH VALLEY, NEVADA.

Nevada Univ. System, Reno. Desert Research Inst. A. S. Navoy, G. F. Cochran, and D. F. Schulke. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-173957, Price codes: A05 in paper copy, A01 in microfiche. Publication No 41069, 1980. 66 p. 18 Fig. 15 Tab, 41 Ref. OWRT-A-081-NEV(1), 14-34-0001-8030.

Descriptors: \*Droughts, \*Conjunctive use, \*Hydrologic models, \*Groundwater management, Water shortage, Water rights, Institutional constraints, Irrigation water, Legal aspects, Economic aspects, \*Water law, \*Nevada, Smith Valley(NV).

The surface irrigation water supplies of Smith Valley in Westcentral Nevada are susceptible to drought. The utilization of conjunctive groundwater for drought mitigation was estimated by converting electrical energy consumption of irrigaconverting electrical energy consumption of irriga-tion wells into total amount of water pumped. The amount of actual conjunctive groundwater pumped was separated from the total pumpage by contrasting pumping in the non-drought years of 1974 and 1975 to the drought years of 1976 and 1977. A lumped parameter systems model was developed for Smith Valley, based upon the char-acteristics and interrelationships of the water re-courses system. Various conjunctive pumping sources system. Various conjunctive pumping management schemes were modeled to investigate improving the drought mitigation capability. Due to the water cost framework, the management schemes simplify to increases in the allowable con-junctive pumpage. The model results indicated that a doubling of the present conjunctive groundwater rights would not manifest itself as a significantly greater groundwater storage deficit. W81-01997

ORGANICS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE-FEDERAL CRITERIA. Nalesnik Associates Inc., Washington, DC. For primary bibliographic entry see Field 5G. W81-02016

INTERMITTENT STREAMS; WATER QUAL-ITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITE-

Nalesnik Associates Inc., Washington, DC For primary bibliographic entry see Field 5G. W81-02017

GENERAL PROVISIONS/FREEDOMS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/ FEDERAL CRITERIA. Nalesnik Associates Inc., Washington, DC.

For primary bibliographic entry see Field 5G. W81-02018

NITROGEN-AMMONIA/NITRATE/NITRITE; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/ FEDERAL CRITERIA.

Nalesnik Associates Inc., Washington, DC For primary bibliographic entry see Field 5G. W81-02019

PESTICIDES; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITERIA.

Nalesnik Associates, Inc., Washington, DC. For primary bibliographic entry see Field 5G. W81-02020

TEMPERATURE; WATER QUALITY STAND-ARDS; CRITERIA DIGEST; A COMPILATION OF STATE/FEDERAL CRITERIA.

Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards. For primary bibliographic entry see Field SG. W81-02021

ANTIDEGRADATION POLICIES; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITERIA.

Nalesnik Associates, Inc., Washington, DC. For primary bibliographic entry see Field 5G. W81-02022

OTHER ELEMENTS; WATER QUALITY STANDARDS; CRITERIA SUMMARIES; A COMPILATION OF STATE/FEDERAL CRITE-

Nalesnik Associates Inc., Washington, DC. For primary bibliographic entry see Field 5G. W81-02023

PHOSPHORUS; WATER QUALITY STAND-ARDS; CRITERIA SUMMARIES; A COMPILA-TION OF STATE/FEDERAL CRITERIA.

Nalesnik Associates, Inc., Washington, DC. For primary bibliographic entry see Field 5G. W81-02024

THE JAPAN SEWAGE WORKS AGENCY - ITS ROLE AND ACTIVITIES,

Japan Sewage Works Agency, Tokyo. T. Kubo.

Journal of the Water Pollution Control Federation, Vol 52, No 5, p 873-877, May, 1980. 6 Tab.

Descriptors: \*Treatment facilities, \*Research and development, \*Sewerage, Technology, Construc-tion, Operation and maintenance, Institutions, Costs, Government, Legal aspects, \*Japan

The responsibilities of the Japan Sewage Works Agency (JSWA), established by the Japan Sewage Works Agency Act, include the construction, operation, and maintenance of public sewer systems. The agency aids local governments in improving The agency and so local governments in inproving sewer systems by training waste water engineers, offering technical assistance, and sponsoring research and development of water pollution control techniques. The costs of JSWA are borne equally by local and federal governments. JSWA has a

### Network Design-Group 7A

council which considers JSWA operating procedures and a board of directors which meets twice a year. JSWA has been primarily engaged in design under consignment agreements with local governments. Local governments make advance payments to the agency to cover agreed-upon costs. Upon completion of the project, JSWA conducts extensive tests, and once the project has been approved, further costs are split between the agency and local government. The Research and Technology Division conducts research, surveys, and tests for technological development. There is also a New Technology Evaluation Committee. (Small-FRC) and construction of waste water treatment plants

A SYNOPSIS OF PERSPECTIVES ON THE IN-NOVATIVE AND ALTERNATIVE TECHNOL-OGY PROGRAM,

Maryland Univ., College Park. Dept. of Civil En-

gineering.

J. E. Alleman, and P. S. Price.

Journal of the Water Pollution Control Federation, Vol 52, No 3, p 460-464, March, 1980. 10 Ref.

Descriptors: \*Federal Water Pollution Control Act. Technology. \*Government finance, Recy-cling, Costs, Energy conservation, Grants, Re-search and development, Cities, Alternative technology, \*Water reuse.

The Clean Water Act of 1977 includes a segment promoting the use of innovative and alternative (I/ A) technology to force technology so that new and better alternatives which have not been dem-onstrated can become available. The three pri-mary objectives of such technology are: recycling and reuse of water and waste materials, energy conservation and recovery, and cost reduction. conservation and recovery, and cost reduction. Incentives for I/A technology applications include an increase in the federal contribution for design and construction from 75 to 85%. If the system fails within two years, the municipality is guaranteed sufficient funds to repair or replace the unit. teed sufficient funds to repair or replace the unit. There has been some congressional displeasure with the constructions grant program, and changes may develop. The public has protested against the program because of excessive operations and maintenance costs, which have led to higher user costs. The program has not been successful in its attempts to move the engineering community towards alternative technology. (Small-FRC) W81-02114

PROBLEMS IN APPLYING OPTIMAL IRRI-GATION PLANS, Idaho Univ., Kimberly. Dept. of Civil and Agri-

Idano Univ., Kimberly, Dept. of Civil and Agri-cultural Engineering. C. E. Brockway, and R. G. Allen. Journal of the Water Resources Planning and Man-agement Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR1, p 255-263, March, 1980. 2 Tab, 8 Ref.

Descriptors: \*Irrigation systems, \*Planning, \*Teton Dam, \*Optimization, Water rights, Water law, Open channels, Conveyance structures, Irrigation canals, Irrigation ditches, Canals, Water conveyance, Irrigation districts, Idaho, Dynamic programming, Linear programming, Salem Irrigation District, Efficiencies, Costs, Dam failure, Rebeliktricts

After the Teton Dam collapse in 1976 destroyed or damaged 65 irrigation districts in eastern Idaho, a taining the same and the same a components. First, dynamic programming was used to build least-cost, efficient, distributionsystem component configurations composed of lined and unlined channels and pipe sections using lined and unined channels and pipe sections using a branch and bound decision technique. Then linear programming was used to obtain least-cost system plans for the entire system. As an example, details for the 3,170 acre Salem Irrigation district are described. In this area, unlined channels with high seepage rates are used for subirrigation. Effiapplication, and energy costs are listed for

8 combinations of irrigation systems—sub-irriga-tion, unimproved furrow and border, improved furrow and border, and 3 types of sprinklers. Some of the constraints involved with planning this of the constraints involved with planning this system were replacement with in-kind structures. farmer acceptance, jeopardization of water rights, increasing inflation, and energy costs. (Cassar-

### 6G. Ecologic Impact Of Water Development

IMPACT OF STREAM ALTERATIONS ON RI-IMPACT OF STREAM ALTERATIONS ON RIPPARTIAN COMMUNITIES IN SOUTHCENTRAL OKLAHOMA, Oklahoma State Univ., Stillwater. Dept. of Ecology, Fisheries and Wildlife.

J. S. Barclay.

Available from the National Technical Information

Stream S

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-166886, Price codes: A06 in paper copy, A01 in microfiche. Fish and Wildlife Service, Biological Services Pro-gram Report FWS/OBS-80/17, August, 1980. 105 p, 11 Fig, 35 Tab, 57 Ref. 14-16-0008-2039.

Descriptors: \*Stream improvement, \*Channeling, Land use, \*Wildlife, \*Vegetation, \*Environmental effects, \*Oklahoma, Wildlife habitats, Birds, Mam-mals, Amphibians, Reptiles, Impoundments, Ripar-ian plants, Grasslands, Aquatic habitats, Erosion.

Concern over continuing losses of productive ri-parian wildlife habitat to extensive channelization and impoundment activities in the southern grass-lands, plus a lack of regional information on alterands, plus a lack of regional miorination of ariet-ation effects led to this study of stream alteration in Oklahoma. Two channelized streams, Rush and Wildhorse Creeks, and one impounded stream, Cobb Creek, were selected for study: they are all major tributaries of the Washita River within grassland ecoregions. Intensive plant and animal surveys were conducted on survey sites along 150 km of the streams. Channelization and land use changes along the two prairie streams resulted in or facilitated extensive loss and degradation of aquatic habitat; complete destruction of wetlands; nearly complete elimination of the bottom land forest; accelerated erosion; and reduced plant and animal species richness, diversity, and relative abundance. Land use was usually the most apparabundance. Land use was usually the most appar-ent factor determining vegetation differences be-tween sites. Although the data on impoundment effects are conflicting from one life group to an-other, there appears to be a general tendency toward lower species diversity and higher relative abundance on the downstream sites, which may reflect the stabilized downstream flow. Exceptional care must be taken to minimize subsequent ero-sion and loss of adjacent riparian plant and animal communities when channelization is authorized for prairie streams. (Moore-SRC) W81-02025

ENVIRONMENT AND WATER DEVELOP-MENT IN THIRD WORLD, Biswas and Associates, Ottawa (Ontario).

Biswas and Associates, Oxides, A. K. Biswas.
Journal of the Water Resources Planning and Management Divsion, Proceedings of the American Society of civil Engineers, Vol 106, No WR1, p 319-332, March, 1980. 2 Tab, 26 Ref.

Descriptors: \*Planning, \*Water resources development, \*Resources development, Social aspects, Environmental aspects, Africa, Aswan Dam, Sedimentation, Public health, Agriculture, Irrigation systems, Diseases, Aquatic weeds, India, Third World.

This paper discusses the social and environmental effects of water development in the third world under three categories--physical, bilogical, and human effects. The positive and negative environ-mental effects of several water resource development projects are discussed--Egypt's Aswan Dam, India's Koyna Dam, irrigation systems and agriculture throughout the world. On a global scale 20 million square km of soil, or 35% of the currently used arable land, has been destroyed or degraded

by poor management. Similarly, water develop-ment projects can affect the biological subsystem in beneficial or adverse ways. Although safe drink-ing water dramatically reduces the incidence of ing water dramatically reduces the incidence of many water-borne diseases, irrigation projects in tropical regions can spread diseases such as schistosomiasis, liver fluke and malaria into new areas and promote growth of undesirable aquatic weeds in waterways. Potable water made easily available to a rural population can improve the life of the water-gatherers, 90% of whom are women. It is not unusual for a person to spend 5 hours every day hauling water. This wastes productive time, uses up dietary calories, and exposes the carriers to disease vectors. However, severe social problems uses up dietary calories, and exposes the carriers to disease vectors. However, severe social problems may result when a large population is forced to move out of the path of a dam inundation. The planning processes must be sensitive to social and environmental guidelines, or the overall strategy may be self-defeating. (Cassar-FRC) W81-02124

### 7. RESOURCES DATA

### 7A. Network Design

AN ORGANIC MONITORING SYSTEM FOR THE OHIO RIVER.

R. C. Kroner. iblic Works, Vol 111, No 5, p 81-84, May, 1980. 2 Fig. 4 Tab.

Descriptors: \*Ohio River, \*Monitoring, \*Organic compounds, Water pollution sources, Carbon tetra-chloride, Solvents, Water quality, Water quality control, Public health, Industrial wastes, Water pollution, Water analysis, Sampling, Gas chromatography, Rivers.

During the winter of 1976-1977, when increased levels of carbon tetrachloride were found in the Ohio River, it became apparent that an early detection and monitoring system for haloform organics was needed to protect the public from these pollut-ants. The Ohio River Valley Water Sanitation Commission (ORSANCO) in cooperation with the US EPA began using 8 semiautomated gas chro-matographs along strategic points of the river to check the level of haloform organics during the first phase of an extensive monitoring plan. A raw water sample is subjected to purge-and-trap treat-ment in the daily analysis, and unknown organics may be identified by more extensive processes. In may be identified by more extensive processes. In 1978 when the program first became operative, it was plagued by problems of untrained operators, equipment failures and lack of maintenance funds. However, the system was successful in detecting high levels of chloroform and carbon tetrachloride ingli levels of cindiformi and caroon tertachioride at the Kanawha River monitoring station, and the discharge problem was rectified after questioning the suspected discharging companies. In the second year of operation, specific discharge patterns of organics at each monitoring station were noted. Once a month duplicate samples are shipped to consultive absorberies where they are analyzed to consulting laboratories, where they are analyzed by GC/MS as a quality control check. The addition of a second detector to handle purgeable non-halogenated compounds will greatly extend the monitoring capacity of the network. Other recom-mendations for more efficient river surveillance include increased sampling frequency and computerized data handling. (Geiger-FRC) W81-01992

HYDROLOGIC NETWORKS: INFORMATION TRANSMISSION

British Columbia Univ., Vancouver. Dept. of Civil

Engineering.

W. F. Caselton, and T. Husain.

Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR2, p 503-520, July, 1980. 4 Fig. 3 Tab, 9 Ref.

\*Hydrologic systems, Descriptors: design, \*Information exchange, Communication, Stations, Design, Data collection, Shannon information theory, Gaging stations, Sites, Synthetic

#### Field 7-RESOURCES DATA

### Group 7A-Network Design

hydrology, Optimization, Vancouver, British Co-

A hydrological data collection network can be assessed by using information theory. The Shannon information theory is applied to this case (daily point precipitation) and is used to provide an optipoint precipitation) and is used to province an opti-mization criterion for networks. An example is a 10-station 'temporary' network in the Vancouver, British Columbia, region, which experiences sig-nificant precipitation variations within the area. The method can compute the optimal number and sites for location of permanent stations. There are several advantages to using information transmis-sion in network design. Stations of a network are sion in network design. Stations of a network are assessed by their joint information conveying capabilities, not by summation of individual capabilities. Since there is no theoretical limit on the number of types of data, design of multipurpose networks is possible. (Cassar-FRC) W81-02119

### 7B. Data Acquisition

ESTIMATION OF THE DOWNSTREAM RIVER WATER QUALITY WITH A POLLUTION LAND-USE DATA BANK,

Institut National de la Recherche Scientifique, Rimouski

D. Couillard, and D. Cluis.

Water Supply and Management, Vol 4, No 4, p 263-268, 1980. 2 Fig. 3 Tab, 9 Ref.

Descriptors: \*Monitoring, \*Water quality, \*Land Descriptors: "Monitoring, "water quality, "Land use, Eutrophication, Nutrients, Nitrogen, Phosphorus, Model studies, Drainage area, Vegetation, Industrial wastes, Water pollution sources, Data storage and retrieval, Municipal wastes, River basins, Farm wastes, Data collections, "Quebec.

In order to alleviate expenditures associated with repetitive monitoring programs, a nutrient-oriented land use data bank based on information from the Mercator square-grid drainage system and from the Canadian Bureau of Statistics (vegetation coverage, land use, population, agriculture, industry) was developed. The bank served as a simple nutrient (nitrogen and phosphorus) transport model, which was tested on the Yamaska River basin, an intensive agricultural area of Quebec, to determine the relative importance of different pollution sources. Industrial pollution information was ob-tained from Scott's Industrial Directory, and a range of anticipated specific nutrient contributions was established based upon available data in the literature. Point-source polluters are associated directly to their outfall sub-basin unit, and non-pointsource-polluters are distributed to the square-grid in proportion to the areas of the municipalities. in proportion to the areas of the municipalities. The model showed good agreement with previous studies of nitrogen and phosphorus transport, and it was also useful in predicting the impact of treatment plants on nutrient loadings. (Geiger-FRC) W81-01951

### DIGITAL ON-LINE CLOSED-LOOP CONTROL FOR WASTE WATER TREATMENT OPER-ATION,

Metropolitan Denver Sewage Disposal District No. 1, CO.

For primary bibliographic entry see Field 5D. W81-02090

#### SURFACE WATER INVENTORY THROUGH SATELLITE SENSING,

National Remote Sensing Agency, Hyderabad

S. Thiruvengadachari, P. S. Rao, and K. R. Rao. Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR2, p 493-502, July, 1980. 6 Fig. 1 Tab, 5 Ref.

Descriptors: \*Remote sensing, \*Surface waters, Water resources, Impoundments, Water storage, Data collections, \*Satellites(Artificial), Tamil Nadu, India, Lakes, Storage, Surveys, Hydrologic data, Measurement, Monitoring, Mapping, Areal.

Satellite sensing was used to monitor area and volume of 17 major reservoirs in Tamil Nadu State, India, to determine the feasibility of estimating water volumes in ungaged lakes used for do-mestic and irrigation water supplies. Information mestic and irrigation water supplies. Information from Landsat, a sun-synchronous near-polar orbiting satellite, was used in regression analysis, which compared ground-based with satellite-derived waterspread area and satellite-derived area with ground-measured water volume. The correlation rate between waterspread areas obtained from satellite and ground observations was 96.6%. The elitie and ground observations was 90.0%. The satellite-derived waterspread area accounted for 83% of the variation in storage volume. Thus, storage volumes for an area of ungaged lakes can be estimated from a second regression equation. These estimates are more meaningful for a large area than for an individual lake. (Cassar-FRC)

### 7C. Evaluation, Processing and Publication

MAPS SHOWING GROUNDWATER CONDI-TIONS IN THE HASSAYAMPA AREA, MARI-COPA AND YAVAPAI COUNTIES, ARIZONA--

Geological Survey, Tucson, AZ. Water Resources

DIV.
H. W. Sanger, and C. L. Appel.
Available from the OFSS, USGS Box 25425, Fed.
Ctr., Denver, CO 80225, Price: \$5.25 in paper copy, \$1.00 in microfiche. Geological Survey Open-File Report 80-584 (WRI), June, 1980. 2 Sheets, 7 Ref.

Descriptors: \*Maps, \*Groundwater, \*Aquifer characteristics, \*Water wells, \*Arizona, Springs, Descriptors: "Maps, "Groundwater, "Aquiter characteristics, "Water wells, "Arizona, Springs, Water levels, Water utilization, Irrigation, Water quality, Specific conductivity, Fluorides, "Hassayampa area(AZ), Maricopa County(AZ), Yavapai County(AZ).

The Hassayampa area includes about 1,300 square miles in west-central Arizona. The area consists of basins filled with alluvial deposits and mountains basins filled with alluvial deposits and mountains composed of crystalline and consolidated sedimentary rocks. The main water-bearing unit is the alluvial deposits, which consist of gravel, sand, silt, and clay. Other water-bearing units consist of crystalline and consolidated sedimentary rocks that may yield a few gallons per minute. In 1978 about 3,000 acre-feet of ground water was withdrawn from the area. Information shown on the maps includes depth to water, altitude of the water level, well depth specific conductance and fluoride consultance. well depth, specific conductance, and fluoride con-centration. Scale 1:125,000. (USGS) W81-02028

### WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1979--VOLUME 1, NORTHEAST

FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.

Sources Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB81-157513, Price codes: A24 in paper copy, A01 in microfiche. Geological Survey Water-Data Report FL-79-1, November, 1980. 549 p, 33 Fig, 1 Tab, 13 Ref.

Descriptors: \*Florida, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperatures, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, \*Northeast Florida.

Water resources data for the 1979 water year in northeast Florida includes continuous or daily dis-charge for 52 streams, periodic discharge for 18 streams, peak discharge for 32 streams, continuous streams, peak discharge for 32 streams, continuous or daily stage for 14 streams, and periodic stage for 1 stream; continuous elevations for 23 lakes and periodic elevations for 28 lakes, continuous groundwater levels for 39 wells and periodic groundwater levels for 997 wells, and quality of water for 28 surface water sites and for 228 wells. These data represent the National Water Data System records collected by the U.S. Geological

Survey and cooperating local, State and Federal agencies in Florida. (USGS) W81-02029

HYDROLOGIC DATA FOR OKALOOSA, WALTON, AND SOUTHEASTERN SANTA ROSA COUNTIES, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div. R. Wagner, C. Lewis, L. R. Hayes, and D. E.

Barr. Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price code: \$30.50 in paper copy, \$3.50 in microfiche. Geological Survey Open-File Report 80-741, 1980. 228 p. 26 Fig. 20 Tab, 20 Ref.

Descriptors: "Hydrologic data, "Water quality, "Groundwater, "Surface waters, "Florida, Groundwater resources, Aquifers, Water wells, Test wells, Water level fluctuations, Pumping, Water yield, Rainfall, Hydrographs, Streamflow, Chemical analysis, Maps, Evaluation, "Okaloosa County(FL), "Walton County(FL), "Santa Rosa County(FL), "Santa

This report presents hydrologic and water-quality data collected within Okaloosa, Walton, and southdata collected within Okaloosa, walton, and south-eastern Santa Rosa Counties in northwest Florida. The data are presented in graphs and tables. Groundwater data include descriptions of wells and test holes, analyses of water quality, water level measurements, hydrographs of water levels and chloride concentrations in wells open to the and cinoriae concentrations in weis open to the upper part of the Floridan aquifer, and municipal and federal facilities pumpage. Surface-water data include streamflow measurements, streamflow hydrographs and analyses of water quality at selected stations. Maps of the area show locations of wells and surface-water stations. (USGS) W81-02043

### 8. ENGINEERING WORKS

### 8A. Structures

THE ASPHALTIC CONCRETE LINING OF A RESERVOIR IN THE EASTERN TRANSVAAL, Ove Arup and Partners (South Africa). G. W. Plant, D. R. Priest, and A. R. Landby. Civil Engineer South Africa, Vol 22, No 9, p 243-249, September, 1980. 9 Fig. 1 Tab, 10 Ref.

Descriptors: \*Reservoir construction, \*Reservoirs, \*Reservoir leakage, Design criteria, Watertight, Prototypes, Materials engineering, Projects, Seepage, Water loss, Technology, Economics, Operage, ation and maintenance, Resources development, Testing, Concrete mixes, \*Asphaltic concrete, South Africa

The design and construction of a raw water storage reservoir in South Africa is described. The age reservoir is situated in the Eastern Transvaal and has a generating capacity of 3600 megawatts. The reservoir has two compartments with a total capacity of 885,000 cubic meters which provide storage equivalent to five days demand. This is the first reservoir in South Africa to use hydraulic asphalt reservoir in South Airica to use hydraunic aspinality concrete as the lining material. Advantages of this material are that with a multi-layer application weaker areas are covered by the use of staggered joints and irregularities can be leveled out. Disadvantages are that in some climates rapid cooling of thin layers occurs, and imperfect fusion may produce blisters and entrap moisture. The mix adopted for the South African reservoir was designed to meet the conflicting requirements of impermeabi-lity, flexibility and stability on the reservoir slopes.

DEVELOPMENT OF AN URBAN HIGHWAY STORM DRAINAGE MODEL BASED ON

StwMM,
Camp, Dresser and McKee Inc., Springfield, VA.
R. J. Dever, Jr., and L. A. Roesner. Available from the National Technical Information

### Structures—Group 8A

Service, Springfield, VA 22161 as PB81-173858, Price codes: A11 in paper copy, A01 in microfiche. In: Proceedings, Stormwater Management Model (SWMM) Users Group Meeting, 19-20 June, 1980, Toronto, Ontario, Environmental Protection Agency Report EPA 600/9-80-064, December, 1980, p 121-132. 2 Fig, 8 Ref.

Descriptors: \*Urban drainage, \*Highways, \*Model studies. \*Storm runoff, Urban runoff, \*Storm drains, Drainage systems, Computer programs, Water quality, Precipitation(Atmospheric), Hydraulic design, Flow, Cost analysis.

The Urban Highway Storm Drainage Model consists of a powerful and flexible set of computer programs for highway drainage analysis and design. The capabilities of the model include statistical analysis of rainfall records, design of drainage systems including locating inlets and sizing pipes, analysis of drainage systems under extreme storm events, and simulation of runoff quality from the highway corridor. The model consists of four related but independent modules: Precipitation Module, Hydraulics/Quality Module, Analysis Module, and Cost Module. The Precipitation Module and Cost Module. The Precipitation Module design storm hyetographs. The Hydraulics/Quality Module simulates time-varying runoff quantity and quality, locates stormwater inlets and sizes the conduits of the major drainage system. The Analysis Module simulates unsteady gradually-varied flow in the drainage system and can be used to analyze complex hydraulic conditions, such as surcharge and backwater, that may be encountered during an extreme storm event. The Cost Module can be used to estimate construction, operation and maintenance, and total annual costs associated with the drainage system. Two significant modifications to the Storm Water Management Model (SWMM) are the inclusion of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the simulation of inlet hydraulics and the addition of the s

## AIR-WATER FLOW IN HYDRAULIC STRUCTURES.

TURES, Water and Power Resources Service, Denver, CO. Engineering and Research Center. H. T. Falvey.

Engineering Monograph 41, December, 1980. 155 p, 56 Fig, 74 Ref, 3 Append.

Descriptors: \*Air demand, \*Air entrainment, \*Hydraulic structures, \*Design criteria, Air-water interfaces, Hydraulic design, Open channel flow, Closed conduit flow, Free surfaces, Model studies, Computer programs, Jets, Pipelines, Intakes, Falling water surface.

The purpose of this report is to summarize the work that has been completed on air-entrainment and air-demand in both open channel and closed-conduit flows. The intent was to produce a concise reference source from which manuals, monographs, and charts for specific applications could be prepared. Methods have been developed to predict the mean air concentration and concentration distribution with open channel flow. A new description of the free water surface in high velocity flow is proposed which more accurately represents actual conditions in high velocity flow. The effect of air entrainment on the performance of a stilling basin can be estimated using a bulked flow concept. A computer program is presented with which the mean air concentration in steep chutes and spillways can be estimated. With exception of a falling-water surface and decreasing flow in pipelines, closed conduit flows require model studies. When properly conducted and analyzed, model studies will yield accurate data for estimating airflow rates. Experimental methods are discussed. A computer program is presented which can be used to predict the airflow rate with a falling-water surface. Design charts are presented for sizing air relief valves and vacuum valves on pipelines. The airflow rate in vertical shafts was found to be extremely dependent upon the flow conditions at the shaft inlet. Equations are included for estimating the airflow rate having various intet conditions.

Factors influencing the airflow rate around free falling jets are discussed. This area is identified as one needing additional research. Equations are presented from which the air entraining characteristics of a jet entering a pool can be estimated. (Moore-SRC) W81-01936

# ANALYSIS OF A CHANCE-CONSTRAINED RESERVOIR CONTROL MODEL, IBM Watson Research Center, Yorktown Heights,

NY.
For primary bibliographic entry see Field 4A.
W81.01050

# SOIL CONDITIONS DICTATE DESIGN OF LAKE WEIR,

Oakland County Drain Commissioner's Office, Pontiac, MI.

Public Works, Vol 112, No 1, p 59, January, 1981.

Descriptors: \*Dams, \*Weirs, \*Soil types, \*Whitehorse Lake(MI), Michigan, Engineering structures, Marl. Sand. Lakes.

A make-shift, deteriorating dam at Whitehorse Lake, Michigan, was replaced with a sheet pile structure after soil borings showed a stable sand base. The work was done in 10 working days at a cost of \$23,850. Sixty square yards of gabion mattress was installed on the downstream side of the weir. The top was protected and smoothed by a welded steel channel. Stone rip-rap stabilized the shoreline. (Cassar-FRC)

#### WATER AND POWER RESOURCES SERVICE PROJECT DATA

Water and Power Resources Service, Denver, CO. Engineering and Research Center. Water Resources Technical Publication, 1981. 1472 p. 8 Tab.

Descriptors: \*Engineering structures, \*Reservoirs, \*Hydroelectric plants, \*Conveyance structures, \*Dams, Water control, Water distribution(Applied), Irrigation water, Storage, Recreation, Domestic water, Industrial water, Costs, Pumping plants, Canals, Construction, \*Projects review.

Water and Power Resources Service projects, substantially complete and in operation, are reviewed in detail with considerable attention to history, costs, beneficiaries, engineering, and productivity. Newer projects in the early stages of construction, and projects which are authorized but not yet started, are treated briefly. Altogether, 135 projects are described. As of 1978, storage and distribution facilities had been constructed to serve 11.4 million acres of land with irrigation water. Crops harvested on farms receiving water from the Service in 1978 were valued at \$4,993 million. Municipal and industrial water, 524,000 million gallons of from Service projects, was delivered to areas populated by 16.6 million people. The 50 hydroelectric powerplants operating in 1978 had an installed capacity of 10.4 million kilowatts, and uprating units at existing facilities over 5 years will provide an additional 1 million kilowatt capacity. The hydroelectric energy totaling 40.6 billion kilowatt-hours generated in 1978 was sufficient to supply the residential needs of over 14 million people. There were 281 recreation areas, including reservoirs and other facilities on Service projects at the end of 1978. Recreational use of these areas increased during 1978 to a new record of 69.9 million visitor days. (Moore-SRC)

# PIPELINE SOLVES FAR WEST RAND MINES WATER PROBLEM,

South African Mining and Engineering Journal, Vol 90, No 4150, p 96-97, May, 1979. 5 Fig.

Descriptors: \*South Africa, \*Pipelines, \*Mine water, \*Mine drainage, Flood protection, Hydraulic gradient, Corrosion control, Steel pipes,

Welded joints, Steel structures, Subsurface drainage, Water transfer.

Gold Fields of South Africa has installed a 28 km pipeline at a cost of R4,500,000 to transport water from the Gemsbokfontein Compartment area to the West Driefontein canal in the Wonderfontein Valley. The pipeline is designed to accept and contain free flowing surface water and prevent it from entering into the mines beneath such as the West and East Driefontein. The pipeline will provide ground stability and safety as well as reducing the need for underground pumping. All portions of the pipeline are below the mean hydraulic gradient. The pipeline is composed of 9 m steel lengths alternately welded or connected by a loose sleeve coupling. Supports are located every 9 m. The project was completed in only four months and water flowed on December 5, 1977. The pipes are lined with Copon E 2300 for corrosion protection. Concor Construction was the major contractor. Since commissioning, flooding has caused some damage that has been repaired. (Seigler-IPA) W81-02049

#### LESSONS FROM THE BAFOKENG DISASTER, Department of Water Affairs, Pretoria (South Africa).

R. T. Rudd. The Civil Engineer in South Africa, Vol 21, No 6, p 155-156, June, 1979.

Descriptors: \*South Africa, \*Bafokeng, \*Slimes dams, \*Mining engineering, \*Dam failure, Dam designs, Dam foundations, Environmental effects, Pollution abatement, Design criteria, Water pollution, Overflow, Operation and maintenance, Ero-

The failure of the slimes dam at Bafokeng has raised concern about the current methods of design, construction, operation and maintenance, and closure measures used for such structures. The Bafokeng dam was designed to provide a 'backstop' for pollution leaving the mine and to provide a water supply. It was located on a poor site with a long crest and was constructed of local materials such as rock, dunite, and slag from the sulfuric plant, rather than concrete. The failure of this dam shows that techniques suitable for one type of mining pollution control cannot simply be applied to all mining slimes dams. Topics of consideration for dam design and construction must include materials, mineral composition, pollution potential, geology, topography, climate, and hydro-meterology. Dam design should consider the importance of siting of a slimes dam and the impact to the environment in the event of failure. After construction, operation rules must be developed according to the design of the particular dam. Slimes dams must not be used to store water required for use or re-circulation. The failure of the Bafokeng dam appears to warrent a review of the current regulations regarding design freeboard and the associated design storms. (Seigler-IPA)

# THE BAFOKENG DISASTER AND ITS LEGAL IMPLICATIONS, Department of Water Affairs, Pretoria (South

Department of Water Affairs, Pretoria (Sout Africa).

R. T. Rudd.

The Civil Engineer in South Africa, Vol 21, No 6, p 146-150, June, 1979. 2 Tab, 2 Append.

Descriptors: \*South Africa, \*Bafokeng, \*Slimes dams, \*Legal aspects, \*Dam failure, Dam designs, Environmental effects, Design criteria, Water pollution, Overflow, Operation and maintenance, Regulation, Mining engineering, Waste disposal.

Following the failure of the Bafokeng slimes dam in November 1974, mine authorities proposed remedial actions in compliance with South Africa's Water Act No. 54. Prior to the failure, the dam contained more than 13 million cu m of platinum slimes that were produced at the Bafokeng South Mine. All surface installations in the path of the slimes flow were destroyed and 12 men were killed when the slimes entered a shaft. Public streams

### Group 8A-Structures

were polluted and a minor fish kill was reported at the Vaalkop Dam. Recommendations of short-, medium-, and long-term steps to assure the safety of the Valkop Dam waters included the construc-tion of overspill rock barrier dams to prevent further runoff during the rainy season and settling basins to stop the spread of the slimes further down the valley. As a long-term action, the construction of safe, environmentally acceptable slimes and tailing dams should be reviewed. The Secretary of Water Affairs requested that all the facts relating to the Bafokeng disaster be released for the benefit of other mining authorities. Regulations pertaining to this disaster are reviewed including regional standards for industrial effluents in terms of chemi-cal and physical parameters, waste water quality standards, safety aspects relating to materials poisonous to humans and animals, and management and design criteria concerning slimes dams that are regulated by the Water Act. (Seigler-IPA)

CAPE TOWN WATER AUGMENTATION SCHEME.

Municipal Engineer (Johannesburg), Vol 10, No 3, p 57-67, May/June, 1979. 16 Fig.

Descriptors: \*South Africa, \*Cape Town, \*Water Descriptors: South Airica, "Cape I own, "Water supply, "Water supply development, Dams, Pipe-lines, Aqueducts, Tunnels, Water conveyance, Pipes, Pumped storage, Concrete construction, Concrete pipes, Construction.

A 35 km aqueduct system is being constructed to deliver water from the Theewaterskloof and Assegaaibos Dams to pipelines in the Eerste and Berg River Valleys in South Africa. The system will give additional water supplies to the rapidly growing areas of Cape Town Banta and Mitchells ing areas of Cape Town, Banta, and Mitchells ing areas of Cape Town, Banta, and Mitchells Plain. The system, the Riviersonderend-Berg-Eerste River water scheme is expected to yield 83,000 MI/year. It is a joint effort by the City Council of Cape Town and the Government's Department of Water Affairs. Construction began in mid-1971 with the building of a 12 km aqueduct through the Franschhoek Mountains from the Theewaterskioof Dam to the Upper Berg River. Six other tunnels are being constructed with the entire system scheduled for completion in early 1981. With the construction of the aqueducts and 1981. With the construction of the aqueducts and dams, the final all-in cost of the project will amount to R110 million. An R23 million contract was awarded in 1976 to Southern Pipeline Contracts for the construction of the pipeline schemes This system should provide adequate water supplies up to 1986 when additional supplies will probably be needed from the Palmiet River. (Seigler-IPA)

HYDROLOGICAL ASPECTS AND A BARRIER TO FURTHER ESCAPE OF SLIMES.

D. C. Midgley. The Civil Engineer in South Africa, Vol 21, No 6, p 151-154, June, 1979. 5 Fig, 3 Tab, 5 Ref.

Descriptors: \*South Africa, \*Bafokeng, \*Slimes dams, \*Dam failure, \*Hydrologic aspects, Design criteria, Mining, Water pollution, Rockfill dams Design flood, Impoundments, Dam construction

On November 11, 1974, the slimes dam at the Bafokeng Mine in South Africa failed following a rainfall of 75 mm in a 2 hour period. Evidence pieced together from eyewitness accounts and from photographs indicates that the dam was not overtopped. The most likely mechanism of failure was piping. To prevent further escape of slimes to overtopped. the environment, a catchment dam was constructed in the local drainage to act as a settling basin. The catchment dam has a height of 6 m and, if empty, can arrest the total runoff from a single storm of 100-year return. The dam, with a crest length of 535 m, is the largest rockfilled dam in South Africa. The dam was completed in March of 1975 and, despite some repairs and additions, it has been quite successful. It is now used as a balancing reservoir for recirculated water and for water supply augmentation. Another plus is the abundant bird-life that has been attracted by the impoundment. (Seigler-IPA) W81-02061

LINKSFIELD RESERVOIR: JOHANNESBURG. Municipal Engineer (Johannesburg), Vol 10, No 3, p 15, 17-19, 21, May/June, 1979. 11 Fig.

Descriptors: \*South Africa, \*Linksfield Ridge, \*Underground storage, Reservoirs, \*Reservoir "Underground storage, Reservoirs, \*Reservoir construction, Environmental effects, Archaeology, Vegetation regrowth, Revegetation, Vegetation effects, Planting management, Excavation, \*Johannesburg.

Extensive preconstruction research was conducted to minimize the environmental effects of the new to minimize the environmental effects of the new underground reservoir located in the Linksfield Ridge in the north-east sector of Johannesburg. South Africa. The reservoir will have a minimum capacity of 32 MI which will provide 24 hours of storage at peak summer demand in 1980. The reser-voir site was investigated by an archeological team in 1977. Several sites were located including a prehistoric settlement of 12 stone structures, sites from the Iron Age, and sites from the Stone Age. from the Iron Age, and sites from the Stone Age. These sites are being excavated and some of them will be reconstructed after the reservoir is completed. The reservoir will have a 5.5 m high cantilever wall with sloping floors for a maximum water depth of 8.69 m. A matrix analysis developed to minimize construction impacts recommended that the working area for the reservoir mended that the working area for the teservoin should be minimized, a cableway should be used for traffic movement, and the construction campshould be fragmented. After construction the reservoir will be covered with earth and revegetated. Spoil from the excavation will be used to build up a boggy area at Gilooly's Farm and to improve an area of Fotheringham Park. (Seigler-IPA) W81-02064

MODELING RESERVOIR SYSTEM WITH PUMPED STORAGE,

Army Engineer District, Savannah, GA. G. F. McMahon, V. R. Bonner, and B. S. Eichert. Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR1, p 239-254, March, 1980. 3 Fig., 4 Tab, 13 Ref.

\*Dams, \*Simulation Descriptors: analysis. \*Pumped storage, \*Reservoir operation, \*Savan-nah River, Georgia, Model studies, Reservoirs, Storage, Reservoir storage, Pump turbines, Recreation, Multiple-purpose projects, Operations, Power system operation, Hydroelectric plants, Water supply, Water storage, Water level fluctuation. ations, Fluctuations.

simulation study was performed on the Savan-A simulation study was performed on the Savainah River, Georgia, reservoir system, which includes 3 tandem dams-Hartwell, Russell (under construction), and Clark Hill. The purpose of the study was to determine the feasibility of installing pump turbines at Russell and predict the effects of pumped storage on recreational, environmental, hydropower, water supply and economic impacts of the 3 dams. Results yielded information useful for future operation of the system and for future water supply studies. Pumped storage would provide greater flexibility in meeting system requirevide greater Hexibility in meeting system requirements, and the ratio of primary energy shortage to system demand was 10% smaller than for system operation without pumped storage. System operation proved more efficient than operation for atsite requirements. This resulted in less pumping energy, reduced pool fluctuations, and a better balance of reservoir storage levels. (Cassar-FRC) WELODIES W81-02068

### 8B. Hydraulics

AIR-WATER FLOW IN HYDRAULIC STRUC-

Water and Power Resources Service, Denver, CO Engineering and Research Center. For primary bibliographic entry see Field 8A. W81-01936

SEDIMENT SUSPENSION IN TURBULENT PIPE FLOW,

Bechtel, Inc., San Francisco, CA. S. T. Hsu, A. van der Beken, L. Landweber, and J.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY11, p 1783-1793, November, 1980. 3 Fig. 1 Tab, 11 Ref.

Descriptors: \*Pipe flow, \*Sediments, \*Turbulent flow, Hydraulics, Suspended load, Pipes, Flow, Turbulence, Diffusion, Eddies, Velocity, Shear, Friction Paricle size

A theoretical diffusion model for sediment suspension in turbulent pipe flow is described, and results of experiments to verify the analysis are presented. The model employs a coordinate system. Flow and suspension are treated as uniform along the pipe. and the model is limited to sediment concentra-tions that are small enough to preserve the axisymmetric distribution of flow properties such as shear stress, diffusivity, and streamwise velocity. For each experiment a fixed quantity of sand was placed in a pipe loop apparatus, and discharge was controlled while velocity profiles were measured across the vertical and horizontal diameters of the discharge. It was found that the velocity distributions were axisymmetric across a central core extending over 85 - 90% of any diameter. Comparisons with data from the literature suggest that the constant values of turbulent diffusivities for moconstant values of turbulent diffusivities for mo-mentum and suspended sediment in pipe flow differ, but not widely. Excellent agreement was obtained between experimental results and the theoretical model. The model has the potential to be modified for large concentrations. (Titus-FRC) W81-02077

GENERAL ALGORITHM FOR ROUGH CON-DUIT RESISTANCE,

Wade, Trim and Associates, Taylor, MI. S. Kumar, and J. A. Roberson. Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY11, p 1745-1764, November, 1980. 14 Fig. 3 Tab, 23 Ref.

Descriptors: \*Algorithms, \*Hydraulic roughness, \*Flow resistance, Hydraulics, Shear, Flow, Mathematical studies, Roughness coefficient, Channels, Physical properties, \*Conduits, Pipes, Friction, Drag, Boundary processes.

A general algorithm for rough conduit resistance is presented, and relevant literature and field applica-tions are discussed. The new contributions of the algorithm include development of a method for utilizing surface roughness profiles for resistance analysis, improved definition of fully rough conduits, and charts to determine flow resistance based on the geometry of the roughness elements. The algorithm addresses shear stress and velocity distribution for varying roughness conditions. Test distribution for varying rouginess conditions. Test measurements of resistance were made for iron pipes and natural streams. Test findings that the friction factor may become almost constant for both a fully rough and a semi-rough boundary under certain conditions were corroborated by the conditions results. Application of the algorithm to analytical results. Application of the algorithm to the strip type of roughness has not yielded satisfactory results. Some error is introduced to the algorithm because the size of the elements is not limited. In addition, the effect of local wake from upstream elements is not addressed, and conditions of very small roughness, in which a viscous sub-layer could affect resistance, are not addressed. (Titus-FRC) W81-02078

### 8C. Hydraulic Machinery

A FIRST IN SOUTH AFRICA: THE STEEN-BRAS PUMPED STORAGE SCHEME. Imiesa (Johannesburg), Vol 4, No 5, p 14-17, 19, 23, 25, May, 1979. 19 Fig.

Descriptors: \*South Africa, \*Pumped storage, \*Steenbras reservoir scheme, \*Hydroelectric

### MANPOWER, GRANTS AND FACILITIES—Field 9

### Research Facilities—Group 9C

plants, \*Reservoir storage, Electric power, Turbines, Penstocks, Intakes, Tunnels, Costs, Surge tanks, Economic prediction, Water supply, \*Cape

The upper reservoir of the Steenbras reservoir scheme will supply water for hydro-electric generation and will act as a reserve storage area for Cape Town, South Africa's water supply. The scheme has been developed jointly by the City Council and by Escom, the area's electric utility. The scheme is designed to minimize the City's overall cost of electricity by reducing its on-peak dependency on the utility. Water is pumped from the lower reservoir to the upper reservoir at night, an off-peak period with cheaper electric rates. This water is then released during on-peak periods to water is then released during on-peak periods to generate power. Extensive care was taken during the civil engineering to blend the works with the environment while maintaining economic optimization. The major components of the scheme include the upper reservoir, the upper intake works, the access adit, the low pressure tunnel, a surge shaft and tank, the high pressure shaft and tunnel, a steel penstock, the power station, and the lower control works and reservoir. Final project costs control works and reservoir. Final project costs are estimated at R65 million or R360 per kilowatt. Within 10 years the cumulative discounted monetary savings are expected to be about R7 million. (Seigler-IPA) W81-02051

### 8D. Soil Mechanics

RAISING STETTYNSKLOOF DAM.

The Civil Engineer in South Africa, p 223-227, September, 1979. 1 Fig.

Descriptors: \*South Africa, \*Stettynskloof Dam, \*Dam construction, \*Rock fill dams, Construction materials, Reservoirs, Water supply, Dam design, Damsites, Earthworks, Impoundments, Spillways,

To raise its existing Stettynskloof concrete dam, the South African municipality of Worchester is constructing a composite earth and rockfill dam downstream of and abutting the concrete dam. The existing concrete dam was built in 1954 and holds 5 million cu m of water with its height of 30 m. The new composite dam will have a height of 48 m. above the river bed level and will increase the reservoir capacity to 15 million cu m. This increase should be adequate to supply the area past the year 2000. Approximately half of the material for the new dam will be rockfill excavated from the river-bed downstream of the dam. Clay will be used for

an impervious core zone. Earthfill materials will be taken from a borrow area in the reservoir basin. An R2.68 million contract was let in 1978 to Savage and Lovemoore Ltd with construction scheduled for completion in 1980. Construction equipment being used includes Caterpillar 769 dumptrucks, a Caterpillar 235 excavator, a Komatsu 085A bulldozer, and a 10 t Dynapac smooth drum and padfoot rollers. (Seigler-IPA) W81-02062

### 8E. Rock Mechanics and Geology

VALIDITY OF CUBIC LAW FOR FLUID FLOW IN A DEFORMABLE ROCK FRACTURE, California Univ., Berkeley. For primary bibliographic entry see Field 2F. W31-01969

THEORETICAL HEAD VARIOGRAMS FOR STEADY FLOW IN STATISTICALLY HOMOGENEOUS AQUIFERS,
Princeton Univ., NJ. Dept. of Civil Engineering. For primary bibliographic entry see Field 2F. W81-01973

### 8I. Fisheries Engineering

STEENBRAS RESERVOIR: TROUT PLANT-INGS AND RECOVERIES,

A. C. Harrison.

A. C. Harrison. Piscator (Cape Town), Vol 32, No 104, p 111-115, Summer, 1979, 5 Tab, 1 Fig.

Descriptors: \*South Africa, \*Steenbras Reservoir, \*Trout, \*Fish stocking, Brook trout, Brown trout, Rainbow trout, Tiger trout, Smallmouth bass, Reservoirs, Fish establishment, Fish populations, Fry, Fish management, Fish reproduction.

Since its completion in 1920 the Steenbras Reservoir, which supplies water to Cape Town, South Africa, has been stocked with brown trout, tiger trout, rainbow trout, and brook trout. The Steenbras Reservoir has acid, peat-stained water which causes problems for trout. Although the trout introduced into the Reservoir have survived and grown, there has been no breeding. Smallmouth bass introduced in 1939 and 1940 have breed prolifically. Of the 76,040 brown trout stocked be-1952 and 1968, only 1,190 or 1.5% were caught and recorded. Scale-readings were used to determine age and to match a fish to its stocking group. Of 5,210 tiger trout, a hybrid brown trout and American Eastern brook trout, released from 1960 to 1967, only 197 or 4% were recovered. Between 1952 and 1954, 21,000 rainbow trout were released, but only 22 recoveries were recorded. Some rainbow trout were reported to have gone over the spillway of the dam. Since 1951, brook trout have also been stocked in the Reservoir, but they are difficult to identify. (Seigler-IPA) W81-02052

EFFECTS OF STREAM HABITAT IMPROVE-MENTS ON INVERTEBRATES, TROUT POPU-LATIONS, AND MINK ACTIVITY, Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources. S. A. Burgess, and J. R. Bider. Journal of Wildlife Management, Vol 44, No 4, p 871-880, October, 1980. 2 Fig. 2 Tab, 23 Ref.

Descriptors: \*Habitat improvement, \*Stream improvement, \*Invertebrates, \*Environmental effects, Brook trout, Crayfish, Mink, Freshwater fish, Fish management, Aquatic habitats, Wildlife management, Wildlife habitats, Aquatic animals, Small animals(Mammals), Lac Carre, \*Queb

A section of spring-fed mountain stream near Lac Carre, Quebec, was altered to provide improved habitat for brook trout. A similar 100 meter section of stream was left unimproved as a control. of stream was left unimproved as a control. Changes included adding small dams of rocks and logs, large boulders, and cover. After 2 years the trout population and biomass in the improved stream increased by 28% and 179%, respectively; crayfish, by 220%. In the improved section, water temperatures were the same as in the control; insect populations were higher. Mink were 52.5% more active near the improved stream but resembled. more active near the improved stream, but preyed mostly on crayfish and small mammals. Analysis of mink scats showed that trout were not an important prey. (Cassar-FRC) W81-02091

### 9. MANPOWER, GRANTS AND FACILITIES

### 9C. Research Facilities

R&D AT EPA: UPHILL RESPONSIBILITIES AND DOWNHILL FUNDING.

For primary bibliographic entry see Field 5G. W81-02113

ACTIVATED CARBON Modeling and Prediction of Specific Compound Adsorption by Activated Carbon and Synthetic	ALKALINITY Prediction of Alkalinity Changes in the Activated Sludge Process,	Comparison of Principles of Development and Use of Water Quality Standards in the USSR and USA,
Adsorbents, W81-02136 5D	W81-02089 5D	W81-01910 3C
	ALLUVIAL AQUIFERS	Effect of Industrial Pollution on the Kalu River
ACTIVATED SLUDGE Prediction of Alkalinity Changes in the Activat-	Digital Model of the Bayou Bartholomew Alluvial Aquifer-Stream System, Arkansas,	Ecosystem, W81-02145 5C
ed Sludge Process, W81-02089 5D	W81-02044 6A	AQUATIC PLANTS
THE PROPERTY OF THE PARTY OF TH	ALTERNATIVE PLANNING	Responses of Submersed Vascular Plant Com-
Oxygen Uptake as a Control Parameter, W81-02098 5D	Fairness Considerations and Alternative Policies,	munities to Environmental Change, W81-02013 5C
ADSORPTION	W81-02125 6A	AQUATIC POPULATIONS
Modeling and Prediction of Specific Compound Adsorption by Activated Carbon and Synthetic Adsorbents, W81-02136 5D	AMINO ACIDS  Gas-Chromatographic/Mass-Spectrometric  Analysis of Derivatized Amino Acids in Munici-	Changes in the Density of Zooplankton Passing through the Cooling System of a Power-Gener- ating Plant,
	pal Waste Water Products, W81-02128 5A	W81-01986 5C
Sorption Capacities of Graphitized Carbon Black in Determination of Chlorinate Pesticide		AQUIFER CHARACTERISTICS
Traces in Water,	AMMONIA	Instability in Aquifer Identification: Theory and Case Studies,
W81-02149 5A	Some Factors Affecting the Toxicity of Ammo- nia to Fishes,	W81-01972 2F
AERATION	W81-01915 5C	Maps Showing Groundwater Conditions in the
Design of Aeration Towers to Strip Volatile Contaminants from Drinking Water, W81-02071 5F	AMMONIA VOLATILIZATION  Volatilization, Plant Uptake and Mineralization	Hassayampa Area, Maricopa and Yavapai Counties, Arizona-1978,
Odor Control of Waste Water Treatment Plants,	of Nitrogen in Soils Treated With Sewage Sludge,	W81-02028 7C
W81-02105 5D	W81-02009 5D	AQUIFERS Theoretical Head Variograms for Steady Flow
AEROBIC TREATMENT Water Quality Conversion Matrix of Aerobic	ANAEROBIC DIGESTION  Determination of Hydrolytic Activities in Waste	in Statistically Homogeneous Aquifers, W81-01973 2F
Biological Processes, W81-02096 5D	Water Systems by Microcalorimetry,	Analytical Study of the Ogallala Aquifer in
AESTHETICS		Sherman County, Texas, Projections of Saturat-
General Provisions/Freedoms; Water Quality	Trace Metals and Anaerobic Digestion of Lea- chate.	ed Thickness, Volume of Water in Storage, Pumpage Rates, Pumping Lifts, and Well Yields,
Standards; Criteria Summaries; A Compilation of State/Federal Criteria.	W81-02094 5D	W81-02000 4B
W81-02018 5G	AQUA FRIA RIVER (AZ)	Analytical Study of the Ogallala Aquifer in
AFRICA Fooding in Zapalanhan	Flood of February 1980 Along the Agua Fria River, Maricopa County, Arizona,	Moore County, Texas, Projections of Saturated Thickness, Volume of Water in Storage, Pum-
Feeding in Zooplankton, W81-02058 5C	W81-02027 2E	page Rates, Pumping Lifts, and Well Yields, W81-02001 4B
AGRICULTURAL RUNOFF	AQUATIC ALGAE	
Pesticides; Water Quality Standards; Criteria Summaries; A Compilation of State/Federal Cri-	Feeding in Zooplankton, W81-02058 5C	Analytical Study of the Ogallala Aquifer in Armstrong County, Texas, Projections of Satu- rated Thickness, Volume of Water in Storage,
teria. W81-02020 5G	AQUATIC ENVIRONMENT	Pumpage Rates, Pumping Lifts, and Well Yields,
AGRICULTURAL WATERSHEDS	A Research Strategy for Anticipating Contami- nant Threats to Aquatic Resources,	W81-02002 4B
Sediment Losses from Small Agricultural Watersheds in Hawaii (1972-77),	W81-01906 5C	Occurrence and Quality of Groundwater in the Edwards-Trinity (Plateau) Aquifer in the Trans-
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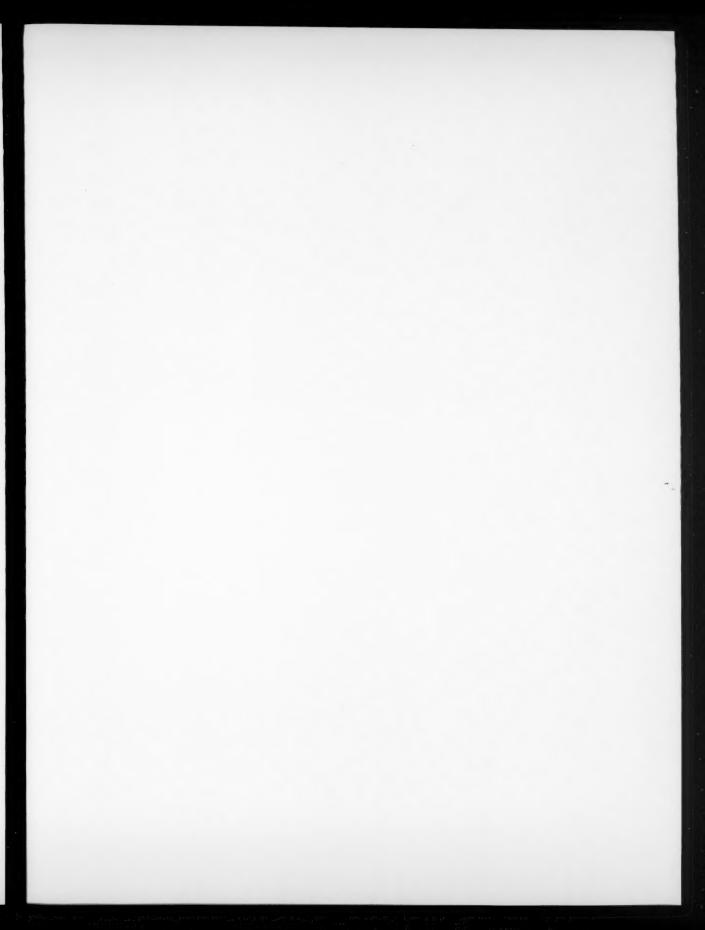
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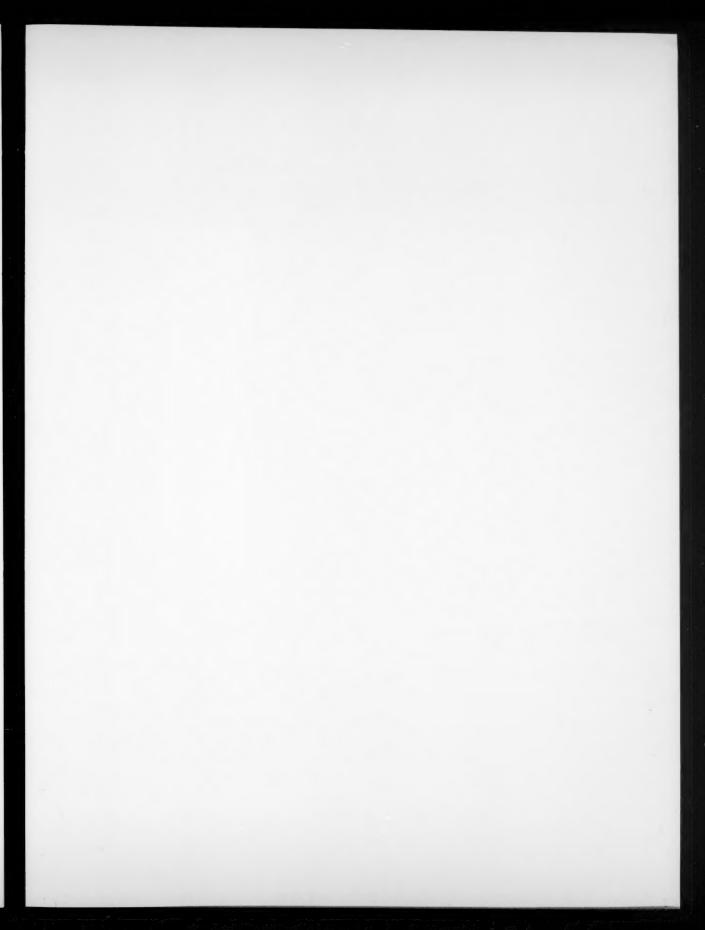
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